



## Town of Redcliff

### Report

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### Inflow-Infiltration Study Wastewater Master Plan Update

April 2015





ISL Engineering and Land Services Ltd. is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.





## Executive Summary

### E1.0 Introduction

ISL Engineering and Land Services Ltd. (ISL) was commissioned by the Town of Redcliff (the Town) to undertake an Inflow-Infiltration Investigation (the Study). This Study included an update / rework of the Town's Wastewater Collection System Master Plan (Wastewater System Evaluation, MPE, 2013), including development of a hydrodynamic system model to improve upon the previous study's recommendations pertaining to system capacity. This project was initiated in response to a need to ensure sound wastewater system planning, as well as to review sanitary wet weather flow rates in the system. The intent of the study is to provide a framework for existing system capacity upgrades, inflow-infiltration reduction measures, and the future wastewater servicing system for the Town as well as to provide capital costing for any remedial measures for capital planning and future off-site levy considerations. This framework should provide a "road map" for the Town to follow to ensure sound wastewater system planning.

### E1.1 Study Objectives

The Study was prepared to achieve the following objectives:

- 1) To develop a hydrodynamic model of the Town's existing wastewater collection system and calibrate it to provide accurate capacity assessment.
- 2) To use the calibrated model to prepare capacity assessment of the existing wastewater servicing system and its ability to perform under existing and growth conditions.
- 3) To determine what, if any, upgrades for existing Town infrastructure are required to meet servicing objectives under existing conditions
- 4) To review existing inflow-infiltration rates observed under wet weather conditions.
- 5) To review possible sources of inflow-infiltration and recommend remedial measures.
- 6) To determine what, if any, upgrades for existing City infrastructure are required to meet servicing objectives under future growth scenarios to a population of 10,000.
- 7) To provide a framework for future wastewater capital planning.
- 8) To provide costs related to infrastructure requirements.
- 9) To comment on possible staging of infrastructure and/or growth areas, where applicable.

### E1.2 Conclusions

Conclusions for the the Study are as follows:

- 1) The Town's wastewater collection system performs adequately under the Alberta Environment 0.28L/s/ha event.
- 2) A 1:50 year, 24 hour, 4<sup>th</sup> quartile Huff storm was selected as a level of service, given is gave reasonable replication of sewer backup issues in the Town.
- 3) The July, 2013 thunderstorm was deemed excessively conservative for a level of service.
- 4) The major constraints in the Town's wastewater collection system include:
  - a. Outfall Sewer to Medicine Hat capacity – this is the primary contributor to sewer backups
  - b. South Trunk sewer capacity
  - c. Northwest lift station (3 Street / 3 Ave NW) as well as select sewer capacity.
- 5) Inflow-infiltration rates in the Town's system can be summarized as follows:
  - a. Northwest – extreme rates that are very unusual

- b. South Trunk – elevated rates typical for an older system
- c. North Industrial – limited inflow-infiltration noted
- 6) Surveys of Town residents noted some items on private lots that could be contributing to inflow-infiltration in the Town. This primarily included sump pumps and some roof leaders. It is noted that this was primarily within the South Trunk catchment.
- 7) Smoke testing did not reveal any major contributors to inflow-infiltration. Some manholes were found to be unsealed.
- 8) CCTV inspection did not reveal any major contributors to inflow-infiltration. It did reveal some deficiencies and debris that could cause capacity constructions.
- 9) There are no obvious causes of the high inflow-infiltration rates in the northwest, so further investigation is required.
- 10) Upgrades are needed to the existing collection system, but decisions on the ultimate servicing plans for the Town must be made to ensure throwaway costs are not incurred.
- 11) It is paramount to get a handle on the upgrade/connection costs in the City of Medicine Hat to be able to establish the proper way forward for the Town in order to act in a fiscally prudent manner.
- 12) There is little to no growth capacity in the Town's system until upgrades are in place either to the City of Medicine Hat, or to a "made in Redcliff" solution.
- 13) Discussions around the Town's preferences for future servicing are required.

### E1.3 Wastewater System – Conclusions

Recommendations for the Study are as follows:

- 1) To reduce inflow-infiltration in the Town, the following are recommended:
  - a. Ensure all manholes are sealed
  - b. Consider a sewer relining program for older sewers where replacement is not required
  - c. Develop an education program to encourage residents to:
    - i. Disconnect sump pumps from the sanitary system
    - ii. Direct roof leaders onto the ground surface
    - iii. Ensure positive drainage away from their homes to reduce flows to weeping tiles.
- 2) Undertake additional flow monitoring in 2015 and beyond within the northwest to try and pinpoint sources of inflow-infiltration. Possible monitoring locations include:
  - a. 4 Street NW north of 3 Ave NW (isolates the north and east parts of the northwest)
  - b. 5 Street NW and 3 Ave NW (isolates the west parts of the northwest)
  - c. 4 Street NW south of 3 Ave NW (isolates the south parts of the northwest)
  - d. 3 Street NW south of 3 Ave NW (though flows might be too low to measure here – it is also noted there is supposed to be flow logging leaving the factory area to this line, which might eliminate the need for a monitor here)
  - e. 4 Ave NW around 1 Street NW or 2 Street NW (start splitting up the north and east parts of the northwest)
  - f. 1 Street NE at 3 Ave NW (isolates the east part of the northwest)
- 3) Before undertaking any existing system upgrades, the Town should:
  - a. Undertake the further flow monitoring in the northwest to see if reduction measures could be successful prior determine its future plans.
  - b. Establish upgrade and connection costs in the City of Medicine Hat for additional flow rates from 200L/s to 500L/s so that a proper cost comparison can be undertaken with other options.



- c. Undertake a discussion to answer the following questions:
    - i. Is the Town comfortable having its growth plans constrained by the City of Medicine Hat?
    - ii. Is the Town willing to consider an option where the Eastside ASP lands are sterilized?
    - iii. Is the Town willing to construct a wastewater treatment facility to facilitate growth?
  - d. Once these costs are established and questions answered, update the option analysis in this report.
- 4) This sets one of three paths forward for recommendations:
- a. If proceeding to service to Medicine Hat, undertake upgrades totaling a cost of \$17.4M+ (subject to upgrades inside City of Medicine Hat) to meet growth of 2,500 (\$12.1M if no growth to be accommodated) :
    - i. Twin sewer to Medicine Hat
    - ii. Twin South Trunk sewer
    - iii. If inflow-infiltration reduction in northwest is not successful, proceed with upgrades in that area.
    - iv. Undertake other minor conveyance upgrades within Town
  - b. If proceeding with surge lagoon option, undertake upgrades totaling a cost of \$18.5M to meet growth of 2,500 (\$9.0M if no growth to be accommodated):
    - i. Construct surge lagoon in Eastside ASP area
    - ii. Twin South Trunk Sewer
    - iii. If inflow-infiltration reduction in northwest is not successful, proceed with upgrades in that area.
    - iv. Undertake other minor conveyance upgrades within Town
  - c. If proceeding with an MBR plant option, undertake upgrades totaling a cost of \$21.5M to meet growth of 2,500 (option was not reviewed without growth):
    - i. Undertake feasibility assessment for MBR plant
    - ii. Undertake feasibility assessment for sewers down escarpment for option 3B and 3C
    - iii. If feasibility assessments are positive, undertake construction of MBR plant and related sewer works. (South Trunk will not require twinning)
    - iv. If inflow-infiltration reduction in northwest is not successful, proceed with upgrades in that area.
    - v. Undertake other minor conveyance upgrades within Town





## Table of Contents

<b>1.0</b>	<b>Introduction / Study Area .....</b>	<b>1</b>
1.1	Authorization .....	1
1.2	Purpose of Study .....	1
1.3	Study Area – Land Use .....	1
<b>2.0</b>	<b>Wastewater System Model Development .....</b>	<b>3</b>
2.1	Model Set-Up .....	3
2.2	Catchment Development .....	4
<b>3.0</b>	<b>Flow Monitoring .....</b>	<b>5</b>
<b>4.0</b>	<b>Model Calibration .....</b>	<b>7</b>
4.1	Dry Weather Flow (DWF) Calibration .....	7
4.2	Wet Weather Flow (WWF) Calibration .....	8
<b>5.0</b>	<b>Existing System Assessment and Upgrades .....</b>	<b>11</b>
5.1	Assessment Criteria .....	11
5.2	Existing System Assessment .....	12
5.3	Town System Test Scenario – Medicine Hat Line Constraint Removed .....	14
<b>6.0</b>	<b>Inflow-Infiltration Review .....</b>	<b>17</b>
6.1	Runoff Rate Review .....	17
6.2	Survey of Town Residents .....	18
6.3	Field Investigation .....	19
6.4	Possible Inflow-Infiltration Reduction Measures .....	21
6.5	Areas for Further Review .....	22
<b>7.0</b>	<b>Existing System Upgrades .....</b>	<b>23</b>
7.1	Level of Service Discussion .....	23
7.2	Medicine Hat Trunk Sewer Capacity .....	24
7.3	Existing System Upgrade Recommendations .....	26
<b>8.0</b>	<b>Future Wastewater Servicing Concepts .....</b>	<b>27</b>
8.1	Future Growth Scenarios .....	27
8.2	System Performance under Growth Conditions .....	28
8.3	Possible Future Wastewater Servicing Concepts .....	28
8.4	Assessment of Wastewater Servicing Concepts .....	35
<b>9.0</b>	<b>Conclusions and Recommendations .....</b>	<b>37</b>
9.1	Conclusions .....	37
9.2	Recommendations .....	38
<b>10.0</b>	<b>References .....</b>	<b>41</b>
 <b>APPENDICES</b>		
Appendix A	Model Files	
Appendix B	Smoke Testing Investigation Report	
Appendix C	CCTV Investigation Report	





## 1.0

## Introduction / Study Area

### 1.1 Authorization

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### 1.2 Purpose of Study

The Study was prepared to achieve the following objectives:

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9. To comment on possible staging of infrastructure and/or growth areas, where applicable.

### 1.3 Study Area – Land Use

The purpose of this Study was not to revisit basic land use considerations for existing and future conditions. Accordingly, this data was obtained from the previous Wastewater System Evaluation (MPE, 2013).







## 2.0

## Wastewater System Model Development

### 2.1 Model Set-Up

It was proposed to deploy an advanced modelling software to assess the performance of the existing sanitary sewer trunks. For that purpose, a hydrodynamic model was constructed based on GIS data provided by the Town, supplemented with survey and spreadsheet data where available. The intention was to take the model and then calibrate using data from a number of flow monitors installed in the Town, to ultimately allow for conducting an assessment of the sanitary system under both Alberta Environment's inflow-infiltration allowance and a theoretical design storm. All processes undertaken in the delivery of the ensuing servicing options are described in detail in subsequent sections.

The computer model utilized to assess the Town's wastewater collection system was MIKE URBAN 2014 by Danish Hydraulics Institute (DHI). MIKE URBAN is a powerful analysis tool that computes inflow from sewage generation rates and rainfall dependent inflow-infiltration, and routes it through the hydraulics system. Based on the hydraulic simulation the model can be used to evaluate which locations have surcharge or flooding conditions. Pipe flows are also determined, and based on peak flows, over-capacity pipes can be identified. The MIKE URBAN model is significantly integrated with the ArcGIS platform and this was used to assist in the construction of the model.

To set-up this model, all available GIS data relevant to the sanitary sewer system in the study area was obtained from the Town. The data for all sewers including manholes, gravity trunks, forcemains and lift stations was then imported into MIKE URBAN.

The five lift stations i.e. Factory, Jesmond Drive, 3<sup>rd</sup> Avenue NW, Semrau and Redcliff Way were set-up in the model from wet well and pump data as per the *Sanitary System Evaluation & Study Report* finalized by MPE in May 2013, which was also supplemented with information provided by the Town of Redcliff. Please note that a number of original pump curves were scaled down to reflect actual lift station discharges based on draw-down tests performed as part of the above mentioned Sanitary System Evaluation by MPE.

Pipe roughnesses were input at typical values (refer to model files attached in Appendix A for further details). Note that these can be refined based on flow monitoring data as part of calibration, but this was not required in this case.

Once data was imported, it was inspected to determine what data appeared missing or erroneous. Generally speaking, the only missing data was manhole inverts. These were input by assuming the manhole invert was equal to the lowest pipe invert connected to the manhole. Potentially erroneous data including flat pipes, inverse sloping pipes, grade breaks, and wrong pipe diameters, was identified and a field verification was carried out by the Town. Generally speaking, the GIS data was accurate and only a few localized revisions were required.

The system as modeled can be seen in Figure 2.1. Model files are attached in Appendix A.

## 2.2 Catchment Development

Following the set-up of the physical sanitary sewer model, it was necessary to delineate the study area into catchment for the purpose of generating dry weather flows (DWFs) and wet weather flows (WWFs). The Town's legal base in a GIS format was leveraged for that purpose as it allowed for more detailed flows allocation rather than typical modeling approach which entails lumping individual lots into larger sanitary catchments.

The Town's total population of 5,600 was distributed amongst all types of residential lots (2,029 in total) to produce a household density of 2.76 persons/household. This is the same approach used in the previous study. Please note that estate residential areas denoted as R-E1 land use with a total population of 44.12 people, located in the very south-west end of the Town, were excluded since there is no servicing to sanitary system. Hence, a total population of 5,555.88 was set-up in the hydrodynamic model. The non-residential catchments such as commercial, industrial and horticultural were set up as an area-based DWF catchments.

The aggregated catchment statistics of the existing system are as follows:

- Residential Catchments:
  - Number of Catchments / Lots: 2,013
  - Total Population: 5,555.88 persons
  - Area: 136.74ha
- Non-Residential Catchments:
  - Total Number of Catchments / Lots: 550
  - Total Non-Residential Area: 268.58ha
    - Commercial Catchments:
      - Number of Lots: 162
      - Area: 54.02ha
    - Industrial Catchments:
      - Number of Lots: 217
      - Area: 151.11ha
    - Horticultural Catchments:
      - Number of Lots: 171
      - Area: 63.45ha



## 3.0 Flow Monitoring

Using the catchments set-up for residential and non-residential areas, the next step was to establish dry and wet weather flows for the study area. To assist in developing realistic sewer flows, the Town had flow monitors installed in a strategic location throughout the Town starting May 17, 2014 until the end of the summer of that year. This flow monitoring data could then be used in conjunction with rain gauge data in the area to allow model calibration for both dry and wet conditions based on flows and rainfall.

Please note the rain gauge was not installed and operational until June 26, 2014 which resulted in missing an opportunity to record rainfall data for a substantial storm event that occurred in early June. Consequently, a RADAR analysis was carried out to perform a WWF calibration which is discussed in more detail in the subsequent section.

For this study, four flow monitors were installed along the main sanitary trunks in key locations. Specific detail on the sites was reviewed with sites shown in Figure 3.1 and can be summarized as follows:

Site FM #93F - This flow monitor was located in the northwest part of the town, immediately upstream of the 3<sup>rd</sup> Avenue lift station. It was installed on a 450mm Polyethylene sewer at the junction with the downstream 525mm PVC pipe. The upstream service area consists of predominantly of residential and horticultural areas along with a number of industrial and commercial lots.

Site FM #DA0E - This flow monitor was located in the southern part of the town, immediately east of the intersection between 9 Avenue SE and Memorial Drive SE. It was installed on a 450mm PVC gravity sewer with a mix of predominantly residential areas along with some commercial and horticultural developments in the upstream service area.

Site FM #D91B - This flow monitor was located on the east end of the town, immediately north of Trans-Canada Highway. It was installed on a 300mm VCT sewer at the junction with an incoming 200mm VCT gravity sewer. The upstream service area consists of predominantly of industrial areas along with a number of horticultural and commercial lots.

Site FM #D8E1 - This flow monitor was located along 1 Street SE roughly 102 meters south of the junction with the 6 Avenue SE. The monitor was installed on a 250mm VCT gravity sewer with a mix of residential and commercial developments within the downtown core in the upstream service area. This site is located upstream of Sites FM #DA0E.

Please note that after Qa/Qc of the recorded data it was determined that this flow monitor did not produce reliable data due to an issue with heavy deposition of silt at the flow monitor. As a result, very low flows were recorded. Two attempts to move this flow monitor to a different location along

1 Street SE yielded no improvement in obtaining quality flow data. Analyzing the recorded flows, it was determined that a weir set-up for the monitor would be appropriate given very low flows. As a result, this flow monitor was excluded for the purposes of calibrating a hydrodynamic model and the downtown core was calibrated using Site FM #DA0E.



## 4.0 Model Calibration

### 4.1 Dry Weather Flow (DWF) Calibration

Following construction of the hydraulic model of the trunk sewer system and the compilation of the flow monitoring data, model calibration was then initiated. This required calibrating the model to accurately represent flows under both dry and wet weather conditions.

The first step in calibrating the model was to determine adequate dry weather periods. This was accomplished by selecting weeks with no or little rainfall present preceded by relatively dry week(s) and resembling typical dry weather sanitary flow patterns. After a thorough review the following dry periods were used:

- May 17-24, 2014 (used to calibrate flow monitoring Site FM #DA0E and #D93F)
- June 23-26, 2014 (used to calibrate flow monitoring Site FM #D91B)

Two of the three sites were calibrated based on the main DWF period of May 17-24, 2014, while the Site FM #D91B based on flow monitoring data recorded from June 23 to June 26, 2014. Please note that Site FM #D91B was located on a trunk conveying flows from predominantly industrial service area with very low flows, resulting in a choppy data. The selected period was deemed appropriate for calibration purposes after a detailed Qa/Qc process was undertaken. As mentioned in previous section, Site FM #D8E1 was excluded from the calibration due to unusable recorded flow values.

The next step was to determine baseflows that generally represent infiltration to the system. This was achieved by setting baseflows to 80% of minimum flows, with the remainder flows deemed to be a product of dry weather flow generations. Consequently, a set of diurnal patterns for residential and non-residential areas were developed for a number of sites as referenced in the model files in Appendix A.

Dry weather flow sewage generation rates were estimated by considering the difference between average flow rates and the defined baseflow rates, then taking the difference and dividing it by upstream residential population and catchment areas for residential and non-residential catchments, respectively.

Catchments were then grouped sequentially based on the next downstream flow monitor. That is to say that once a dry weather flow rate was estimated for catchments upstream of one flow monitor, this information was used, in conjunction with data from the next downstream flow monitor to determine dry weather flow rates for catchments downstream of the upstream flow monitor, but upstream of the downstream flow monitor, then repeating until reaching the end of the study area.

On this basis, residential, commercial, horticultural and industrial dry weather flow rates were estimated and adjusted as necessary to account for variations in diurnal patterns to yield dry

weather flow generation rates of in the range of 200L/p/d, 5.00 to 6.00m<sup>3</sup>/ha/da, 4.72-17.28m<sup>3</sup>/ha/da and 1.00m<sup>3</sup>/ha/da, respectively.

A detail breakdown of residential and non-residential dry-weather-flow generation rates used for each flow monitoring site is shown in Figure 4.1, while DWF comparison plots are shown in Figures 4.2 through 4.4. Dry weather flow calibration summary results are found in Table 4.1.

## 4.2 Wet Weather Flow (WWF) Calibration

Wet weather calibration is necessary to ensure the model accurately represents the amount of inflow/infiltration (I-I) to the sanitary sewer system during wet weather events. To do so, it was necessary to establish wet weather periods during which a response to the wet weather was observed in the flow monitoring data.

Consequently, the WWF calibration was done based on a major rainfall event of June 18, 2014 that was preceded by another three days (June 13, 14 and June 17) of substantial rainfall that resulted in significant sanitary inflow-infiltration (I-I) response Town-wide. As a result, the WWF calibration period was established from June 13 to 26, 2014 to allow for sufficient regression of baseflows until typical dry weather flows were observed.

As mentioned in Section 2.0, the rain-gauge that was installed by the Town was not operational until after this wet period. Consequently, it was decided to develop a rainfall hyetograph based on the historical RADAR data as per the Environment Canada's weather radar website. For that purpose a weather radar located in Schuler, Alberta was used to extract 10-minute rainfall intensities based on a 14-color resolution RADAR images. These intensities were then converted into rainfall depths so that a rainfall depth hyetograph can be imported into the hydrodynamic model for calibration purposes.

Environment Canada recorded the following rainfall depths during the four rainy days:

- June 13, 2014 – 12.3mm
- June 14, 2014 – 11.8mm
- June 17, 2014 – 18.9mm
- June 18, 2014 – 20.9mm

Please note that the Qa/Qc process indicated that the velocity sensor for Site FM #D91B was found to malfunction resulting in lack of reliable resultant flows. Consequently, this site was omitted from the WWF calibration, and in lieu a set of typical WWF parameters were assigned to affected catchments based on the existing land-use of upstream areas.

The hydrodynamic model was calibrated by utilizing a Time-Area surface runoff method enhanced by the Rainfall Dependent Inflow-Infiltration (RDII) model to create a robust replication of surface and subsurface processes. To achieve this, an extensive sensitivity analysis on a number of Time-Area and RDII parameters was performed. The most notable parameters are as follows:

- Time-Area Model
  - Percent Imperviousness



- Rainfall Dependent Inflow-Infiltration Model
  - Percent Area Contributing to RDII (RDII %)
  - Surface Storage (Umax)
  - Root Zone Storage (Lmax)
  - Overland Coefficient (CQof)
  - TC Overland flow (CK)
  - TC Interflow (CKif)
  - TC Baseflow (BF)

Prior to calibrating the above-mentioned parameters, the Root Zone Moisture (L) parameter was set to 40mm from the default value of 0mm to initialize the soil moisture conditions. Though this value was obtained for pasture soils around Redcliff from the Alberta Agriculture's Soil Moisture maps dated June 17, 2014, it is appropriate to assign an initial soil moisture value of 40mm as it assumes realistic antecedent moisture conditions. This approach was successfully used in a number of studies done for other municipalities in Alberta.

The results of the WWF calibration, where the aforementioned parameters were adjusted until an acceptable agreement between the modelled and observed peak flows as well as volumes were achieved are tabulated in 4.2.

Table 4.2 – Wet Weather Calibration Summary

Flow Monitor	Calibration Period	Peak Flow			Volume		
		Monitored	Modelled	Difference	Monitored	Modelled	Difference
		(L/s)	(L/s)	(%)	(m <sup>3</sup> )	(m <sup>3</sup> )	(%)
Site #DA0E	June 13-26, 2014	113	109	-3.5%	31,866	31,747	-0.4%
Site #D93F <sup>1</sup>	June 13-22, 2014	113	64	-43.4%	23,603	15,214	-35.5%

Notes:

- 1) The recorded WWF flows are believed to be faulty as the flow monitor was located immediately upstream of the 3rd Ave NW lift station resulting in questionable data for the WWF calibration. Hence, Site #D93F was calibrated based on a stipulated maximum HGL along upstream sewers which is believed to peak roughly half-way above pipe crown and below ground surface. This was achieved by setting the percent impervious area to 4%. This approach was deemed acceptable and conservative as the total rainfall depth recorded on June 18, 2014 is 20.9mm, which is close to a recorded total rainfall depth of 22.85mm on August 20, 2014 that resulted in the surcharge to surface in the NW area of Redcliff. This agrees with the assumption that the antecedent moisture conditions were drier during June event as expected and therefore no sewage spillage to surface was reported at the time.

The geospatial allocation of Percent Impervious Area and Percent Area Contributing to RDII values is shown in Figures 4.5 and 4.6 respectively. The comparative plots of modeled versus monitored flows for all flow monitors during the analyzed period is shown in Figure 4.7 and 4.8. It is noted that a comparison at the sanitary gate to Medicine Hat was not undertaken, as it was proven that there were flow measurement issues at the City's flow monitor there, which were leading to erroneous readings.

The final WWF calibration parameters for the study area are summarized in Table 4.3:

Table 4.3 – Wet Weather Calibration Parameters

Parameter	Units	Site #DA0E	Site #D93F	Non-Calibrated Sites
<b>Model A</b>				
Imperviousness	%	1.80	4.00	0.30
Initial Loss <sup>2</sup>	mm	0.6	0.6	0.6
Time of Concentration <sup>2</sup>	min	7.0	7.0	7.0
TA Curve <sup>2</sup>		TA Curve 1	TA Curve 1	TA Curve 1
Reduction Factor <sup>2</sup>		0.9	0.9	0.9
<b>RDII Model</b>				
RDI %	%	10.00	10.00	1.00
Snow Melt		0.0	0.0	0.0
Umax	mm	2.5	2.5	2.5
Lmax	mm	80.0	80.0	80.0
Cqof		0.90	0.60	0.30
Carea		1.0	1.0	1.0
Ckof	hrs	9	10	10
Ckif	hrs	50	50	50
BF	hrs	150	150	150
TOF		0.0	0.0	0.0
TIF		0.0	0.0	0.0
TG		0.0	0.0	0.0
Sy	mm	0.1	0.1	0.1
GWLmin	m	0	0	0
GWLBO	m	10	10	10
GWLFL1	m	0	0	0
U	mm	0.0	0.0	0.0
L	mm	40.0	40.0	40.0
GWL	m	10	10	10
OF	mm/hr	0	0	0
IF	mm/hr	0	0	0





## 5.0

## Existing System Assessment and Upgrades

### 5.1 Assessment Criteria

The primary objective of this study is to review the capacity of the existing wastewater collection system as it pertains to growth. As a corollary to this assessment, however, an assessment of the existing system was considered.

To properly understand level of service considerations, it is necessary to consider The Town's desired level of service (L.O.S) in terms of wet weather flow for its sanitary sewer system. In discussions with The Town, it was noted that a number of approaches have been used by municipalities in Alberta in the past. The first and widely used L.O.S standard is the 0.28L/s/ha inflow-infiltration allowance for new developments published by the Alberta Environment. It is important to note that while the 0.28L/s/ha standard is used for the design of new sanitary sewers, many other municipalities assess their existing sanitary sewer systems on the basis of the return period of rainfall event (or return period of sewer flow magnitude). They then determine a return period that the system should be able to handle without experiencing surcharge problems. This approach is used to define a target to design system upgrades towards, not as a requirement for older areas to meet, as typically these areas exhibit much higher inflow-infiltration rates. The third approach to determine the performance of a sanitary system is to use a historical rainfall event that is known to cause significant property damage and have detrimental environmental impacts.

Based on the above, it was decided to assess the performance of the Town's existing sewer system under the following three WWF scenarios to assist the Town with selecting the desired L.O.S for the future system assessments:

- Inflow-Infiltration standard of 0.28L/s/ha as per the Alberta Environment's guidelines
- 1 in 50-year 24-hour 4<sup>th</sup> Quartile Huff Storm based on the City of Calgary's IDF curve. Please note that this is a newly accepted assessment rainfall event for the City of Calgary that was found to replicate best the observed sanitary response in the City-wide sewer network. While, it would make sense to apply this approach using the City of Medicine Hat's 50-year rainfall depth of 97.2mm (with a peak intensity of 15.795mm/hr), it was found that this would not only result in more severe rainfall event as the one used by the City of Calgary which has the 50-year rainfall depth of 80.8mm (with a peak intensity of 13.13mm/hr), but it would also be more severe than the thunderstorm recorded on July 6, 2013 as per below. Accordingly, the 80.8mm Calgary based storm was employed.
- July 6, 2013 Thunderstorm – this is a historical rainfall event that has resulted in significant property damage within the Town of Redcliff. A RADAR analysis was carried out to derive a rainfall hyetograph to be used in the model. This analysis used RADAR imagery that was used to develop a frequency pattern that was then scaled using observed rainfall at the Environment Canada rain gauge at Seven Persons (the Medicine Hat rain gauge failed at this time).

### 5.1.1 Allowable Surge Criteria

The maximum allowable surcharge (HGL) in the gravity portion of the sanitary sewer systems must remain at least 2.5 meters from the ground surface during a design storm scenario. The following exceptions to this criterion are as follows:

- Catchment areas that have experienced a re-occurring basement flooding following less than 50-year return period rainfall events in the past. In those instances upgrades may be triggered even if modeling results indicate that a surcharge level is below 2.5 meter from the ground surface.
- Gravity pipe sections where there are no service connections and therefore no basement the freeboard may be less than 2.5 meter (e.g. siphon locations away from development crossing, sewers running within green spaces)

Beyond these criteria, there were some minor exemptions allowed, as per the following:

- Nominal surcharge above the pipe crown along a short section of sewer (a few pipe lengths) where no immediate basement connection exists was deemed acceptable.
- In deep sewers with a cover greater than 2.5 meters below the ground surface and no proximity to basement connections, a nominal surcharge above the pipe crown (existing and/or proposed trunks) was deemed acceptable based on the cost-benefit consideration.

## 5.2 Existing System Assessment

Prior to the system assessment as it pertains to growth, it was imperative to indicate system deficiencies for the existing system first.

The performance of the existing network was assessed in terms of two relationships as follows:

*Peak HGL Elevation Relative to the Ground* – the amount of freeboard between the maximum water elevation and ground elevation at each manhole at the moment when maximum flow passes through. As mentioned above the minimum freeboard required is 2.5 meters below ground (some exceptions apply).

*Peak Discharge Relative to Pipe Capacity* – indicates the ratio peak flow to pipe capacity in wet weather conditions; as a corollary to this, the data can be interpreted to indicate the amount of spare capacity during peak flows. This is calculated by taking a ratio of a modelled peak flow in a pipe and its corresponding capacity. Pipes with ratios higher than one are considered to have no spare capacity thus indicating a section of trunk that might require upgrading, particularly where the length of the section is long enough to cause surcharge conditions immediately in the upstream reach.

On the basis of the assessment criteria defined above, the results of this assessment in are included as follows (discussion to follow):

- 0.28L/s/ha scenario



- Plan View of Results on Figures 5.1 and 5.2
- Key Plan for Longitudinal Profiles on Figure 5.3
- Longitudinal Hydraulic Grade Line (HGL) Profiles on Figures 5.4.1 to 5.4.12
- 50-yr 24-hr Huff Q4 Storm scenario
  - Plan View of Results on Figures 5.5 and 5.6
  - Key Plan for Longitudinal Profiles on Figure 5.3
  - Longitudinal Hydraulic Grade Line (HGL) Profiles on Figures 5.7.1 to 5.7.12
- July 6, 2013 Thunderstorm scenario
  - Plan View of Results on Figures 5.8 and 5.9
  - Key Plan for Longitudinal Profiles on Figure 5.3
  - Longitudinal Hydraulic Grade Line (HGL) Profiles on Figures 5.10.1 to 5.10.12

### 5.2.1 0.28L/s/ha Scenario Discussion

Under the 0.28L/s/ha scenario, the following are noted:

- The system within Town appears to perform acceptably.
- There are a number of manholes that show HGL within 2.5m of ground. That said, this is generally due to sewer installation depth, as opposed to elevated grade lines.
- There are limited numbers of sewers in Town that are close to or over capacity.
- HGL profiles within Town do not show elevated HGLs.
- HGL profiles 1, 6, 7, and 8 show an elevated HGL at the downstream end. This is due to the line to Medicine Hat being over capacity.

Broadly depicted, under this scenario, the system performs adequately and does not require upgrades, except for the line to Medicine Hat, which does require an upgrade.

### 5.2.2 50-yr 24-hr Huff Q4 Scenario Discussion

Under the 50-yr 24-hr Huff Q4 Storm scenario, the following are noted:

- There is definite degradation of the system noted.
- There are manholes that indicate surcharge to ground level. These are generally along the South Trunk, the East Trunk, and within the northwest upstream of the 3 St/3 Ave NW lift station.
- There are an increased number of manholes that show HGL within 2.5m of ground. These are generally located in areas noted above as having surcharge to ground.
- A number of sewers within Town are over capacity. These include the South Trunk, much of the northwest, and some sewers within the Town core, specifically 1 Street SE and some sewers downstream of the Jesmond forcemain.
- Similarly to the 0.28L/s/ha scenario, HGL profiles 1, 6, 7, and 8 show an elevated HGL at the downstream end. This is due to the line to Medicine Hat being over capacity.
- Profile 1 shows the elevated HGL propagating upstream into the Town core along 9 Ave SE, but not much further north (refer to Profile 2A, 2B, 3, 4, 5).

- Profiles 9 and 10 show serious surcharge issues. It is noted that the grade lines are high at the 3 St / 3 Ave NW lift station, suggesting it cannot achieve this level of service in its present state.

### 5.2.3 July 6, 2013 Thunderstorm Scenario Discussion

Under the July 6, 2013 scenario, the following are noted:

- The system fails worse than under the Huff storm.
- There are manholes that indicate surcharge to ground level. These are generally along the South Trunk, the East Trunk, and within the northwest upstream of the 3 St/3 Ave NW lift station, but in a larger quantity than for the Huff storm.
- There are an increased number of manholes that show HGL within 2.5m of ground. These are now occurring in many parts of Town, with surcharge propagating north from 9 Ave SE, similar to that which was observed in Town during that event.
- A significant number of sewers within Town are over capacity. These include the South Trunk, much of the northwest, and many north – south sewers within the Town core, specifically 1 Street SE, 2 Street SE, 3 Street SE, 4 Street SE, 6 Street SE and some sewers downstream of the Jesmond forcemain and along Main Street.
- Similarly to the other scenarios, HGL profiles 1, 6, 7, and 8 show an elevated HGL at the downstream end. This is due to the line to Medicine Hat being over capacity.
- Profile 1 shows the elevated HGL propagating upstream into the Town core along 9 Ave SE, but now it does propagate a further 400m to 600m or so to the north (refer to Profile 2A, 2B, 3, 4, 5).
- Profiles 9 and 10 again show serious surcharge issues (but not much worse than the Huff storm due to surcharge to surface). It is noted that the grade lines are high at the 3 St / 3 Ave NW lift station, suggesting it cannot achieve this level of service in its present state.

### 5.2.4 Discussion

There is the question of what level of service is appropriate for the Town. This discussion will be covered in Section 7.0 below when costs are considered. For the moment, however, given the Town has experienced sewer backups, it seems appropriate to discard the 0.28L/s/ha scenario and focus on the latter two. They both have the common issue of capacity constraints in the line to Medicine Hat. To test the impact of this, the Huff storm was run with a free outfall condition at that line to see the actual performance of the Town's system in the absence of that constraint.

## 5.3 Town System Test Scenario – Medicine Hat Line Constraint Removed

For reasons noted above, as a test case, the Huff storm scenario was run with a free outfall to the City of Medicine Hat, as if the line there had been upgraded.

The results of this are summarized as follows:

- Plan View of Results on Figures 5.11 and 5.12
- Key Plan for Longitudinal Profiles on Figure 5.3
- Longitudinal Hydraulic Grade Line (HGL) Profiles on Figures 5.13.1 to 5.13.2



Under the 50-yr 24-hr Huff Q4 Storm scenario with the Medicine Hat outfall sewer upgraded, the following are noted:

- There is definite degradation of the system noted, though it is slightly better than without the outfall line upgraded.
- There are still manholes that indicate surcharge to ground level. These are generally along the South Trunk and within the northwest upstream of the 3 St/3 Ave NW lift station. The east trunk no longer shows surcharge to surface.
- There remain a similar number of manholes which show HGL within 2.5m of ground.
- A number of sewers within Town are over capacity. These include the South Trunk, much of the northwest, and some sewers within the Town core, specifically 1 Street SE and some sewers downstream of the Jesmond forcemain. This is similar to previous findings.
- HGL profile 1 shows a rapidly rising HGL along the South Trunk. This suggests surcharge here is not solely caused by the capacity of the line to Medicine Hat. It shows the elevated HGL propagating upstream into the Town core along 9 Ave SE, but not much further north (refer to Profile 2A, 2B, 3, 4, 5).
- Profiles 6, 7, and 8 now show no issues.
- Profiles 9 and 10 remain as previous, showing serious surcharge issues. It is noted that the grade lines are high at the 3 St / 3 Ave NW lift station, suggesting it cannot achieve this level of service in its present state.

This test case shows that under the Huff Storm, and, as a corollary, the more extreme July 6, 2013 Thunderstorm, there are issues remaining in the Town's system. Upgrade discussions as well as level of service follow in Section 7.0.





## 6.0 Inflow-Infiltration Review

Based on the results found in Section 5.0, which show that the Town's system can meet the 0.28L/s/ha scenario, but not the other scenarios, it is apparent that the inflow-infiltration rates in the Town's wastewater system exceed the 0.28L/s/ha threshold. It is noted that this is expected in any existing wastewater system, particularly in one which is largely several decades or more in age. The next step was to review inflow-infiltration in the system. This was done through use of the calibrated system model, surveys, and field investigation to help quantify it and find the sources.

### 6.1 Runoff Rate Review

To test the potential runoff rates generated in the system, a combination of flow monitoring data review, as well as checking runoff rates generated by the Huff and Thunderstorm scenarios was undertaken. Table 6.1 summarizes rates observed through flow monitoring, while Table 6.2 summarizes rates established in the calibrated model.

Table 6.1 – Observed Inflow-Infiltration Rates based on Flow Monitoring Data

FM Site	DWF	WWF	Difference	WWF/DWF Ratio	Upstream Area	I-I Rate
	Peak Flow (L/s)	Peak Flow (L/s)	(L/s)		(ha)	(L/s/ha)
D93F	30	146.48	116.48	4.88	70.34	1.66
DA0E	33	113.07	80.07	3.43	166.79	0.48
D91B	9	14.6	5.6	1.62	135.73	0.04

Table 6.2 – Modelled I-I Rates

Site Name / Area	Average Peak Runoff Rate (L/s/ha)	
	July 6 2013 Thunderstorm	50yr 24hr Huff Q4 Design Storm
#D93F (NW Area)	10.07	1.55
#DA0E (South Area)	4.60	1.06
#D91B & Non-FM'ed (NE Area)	0.75	0.11

These results give clarity to the reason for the failures in the Town system under the assessment events. The observed rates readily exceed the 0.28L/s/ha criteria in both the South Trunk (Site DA0E) which is nearly double this rate and the northwest (Site D93F), which is roughly six times this rate. Under these sorts of rates, most sanitary systems would experience backups. It is noted that observed rates in the South Trunk are not atypical for a system of this age, whereas the northwest rates suggest serious issues which warrant field investigation.

Under the modelled results, even higher rates are observed. The Huff storm is generating over 1L/s/ha in most of the Town (except for the NE Industrial), while the Thunderstorm is generating extreme flow of 4 to 10 L/s/ha in most of the Town. These rates generally suggest that remedial measures may be needed and that field investigation is warranted.

## 6.2 Survey of Town Residents

To help pinpoint sources of inflow-infiltration, a survey of Town residents was undertaken in August to September of 2014. The purpose of this survey was to identify locations with noted sewer backups, as well as potential inflow-infiltration contributors, such as connected roof leaders or sump pumps. The rationale for this approach is that the Town does not have free access to private property to check these items. It was believed that the residents would volunteer such information, as it is in their best interests to have such items know for possible remediation. To assist in getting resident buy-in, an open house detailing the purpose of the study and the purpose of this Study was held on June 19, 2014.

The results of this survey are as follows:

- Figure 6.1 shows residents reporting sewer backup
  - Generally, the data appears largely random, except for a clustering of results along Main Street north of 8 Avenue SE, and some results along 1 Street SE, also just north of 8 Avenue SE
- Figure 6.2 shows residents reporting their roof leaders going to an unknown destination (it was presumed that if they discharged to surface that residents would know this).
  - Generally, the data shows some possible lot based issues. This data could be validated with smoke testing (roof leaders would smoke if connected to sanitary); this was subsequently done and is discussed below in Section 6.3.
- Figure 6.3 shows residents reporting weeping tile to an unknown location or to the sanitary system.
  - Generally, there is a decent number of possible issues reported here – reports are heavily clustered in the central to south parts of Town. It could help to explain the inflow-infiltration rates in the South Trunk, but not the northwest.
- Figure 6.4 shows residents reporting sump pumps discharging to an unknown location or to the sanitary system
  - Generally, there is a decent number of possible issues reported here – reports are generally clustered in the central parts of Town. As with weeping tiles, it could help to explain the inflow-infiltration rates in the South Trunk, but not the northwest.
- Figure 6.5 shows residents reporting basement drains to sanitary or an unknown location
  - Generally, data is clustered in the south. This is less of an issue than weeping tiles or sump pumps which can discharge groundwater or infiltration, but is taken to note.
- Figure 6.6 shows residents reporting backups in June 2013.
  - This is taken as information. Backups are too isolated to be due to systemic issues.
- Figure 6.7 shows residents reporting backups in July 2013.
  - This data is useful, as it validates the data about system backup from the South Trunk. Data shows backups north of 8 Avenue SE, particularly along Main Street, 1 Street SE, and 2 Street SE.





Generally speaking, this information was taken as information, with some of the physical system issues to be validated during field investigations, as denoted below and commentary/recommendations to follow based on that discussion.

### **6.3 Field Investigation**

The inflow-infiltration field investigation undertaken consisted of two programs:

1. Smoke Testing in August – September of 2014
2. CCTV Pipe Inspection in September of 2014

#### **6.3.1 Smoke Testing**

The purpose of smoke testing is to see locations where non-toxic smoke, concentrated in the sewer system will escape. The logic here is to

SFE Global was retained to undertake smoke testing. Results of the smoke testing are shown on Figure 6.8, with a detailed report attached in Appendix B.

Broadly depicted, this program found eleven manhole covers that are not sealed, as well as a couple of roof leaders, and a few service connections and cleanout caps that showed smoke release. Generally speaking, these would be considered to be contributors to the issue, but unfortunately, there was no proverbial “smoking gun” found. There are easy gains to be made through sealing manhole lids which will help with inflow-infiltration in the South Trunk (though it is unlikely that a single manhole unsealed would contribute more than 0.5L/s under an extreme event, making this reduction perhaps up to 5L/s, which is only 1/16<sup>th</sup> of the observed wet weather flow), but the northwest remains largely unexplained from this program and will require alternative review measures. Refer to 6.4 below for additional commentary.

#### **6.3.2 CCTV Inspection**

The purpose of CCTV inspection is to review the condition of existing pipes in certain locations. Typical items for review include pipe failures (cracking, collapse, displaced joints) that could provide sources for infiltration, as well as to look for possible capacity constrictions (collapsed pipe, roots, etc.).

SFE Global was retained for the CCTV pipe inspection. The CCTV inspection report is attached in Appendix C, with snapshots showing the locations inspected below in Figure 6.9 and 6.10 (note that full size versions of these are included in Appendix C, in the Appendix II section of the SFE report.

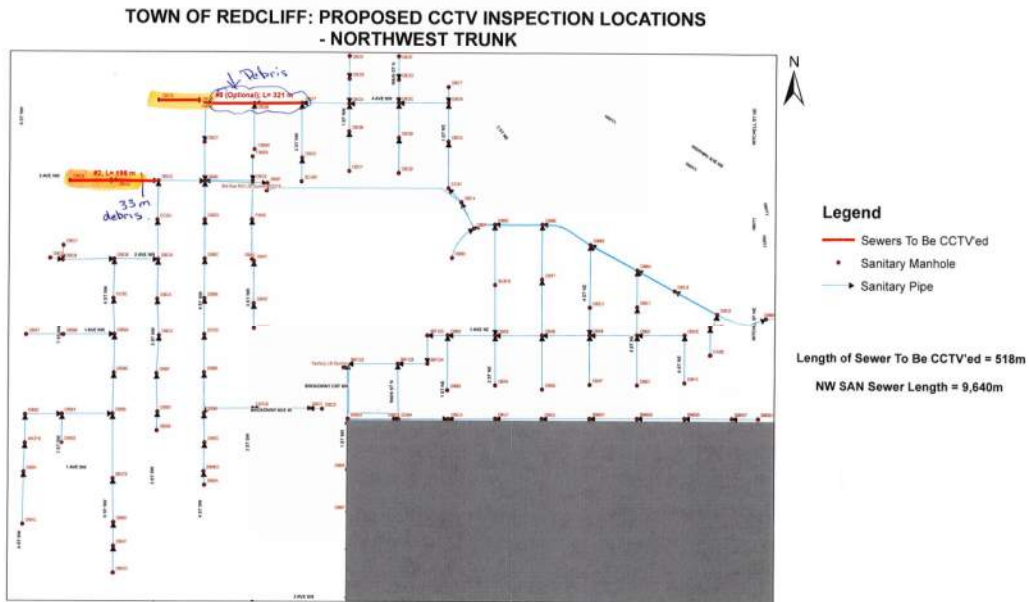


Figure 6.9 – NW CCTV Inspections

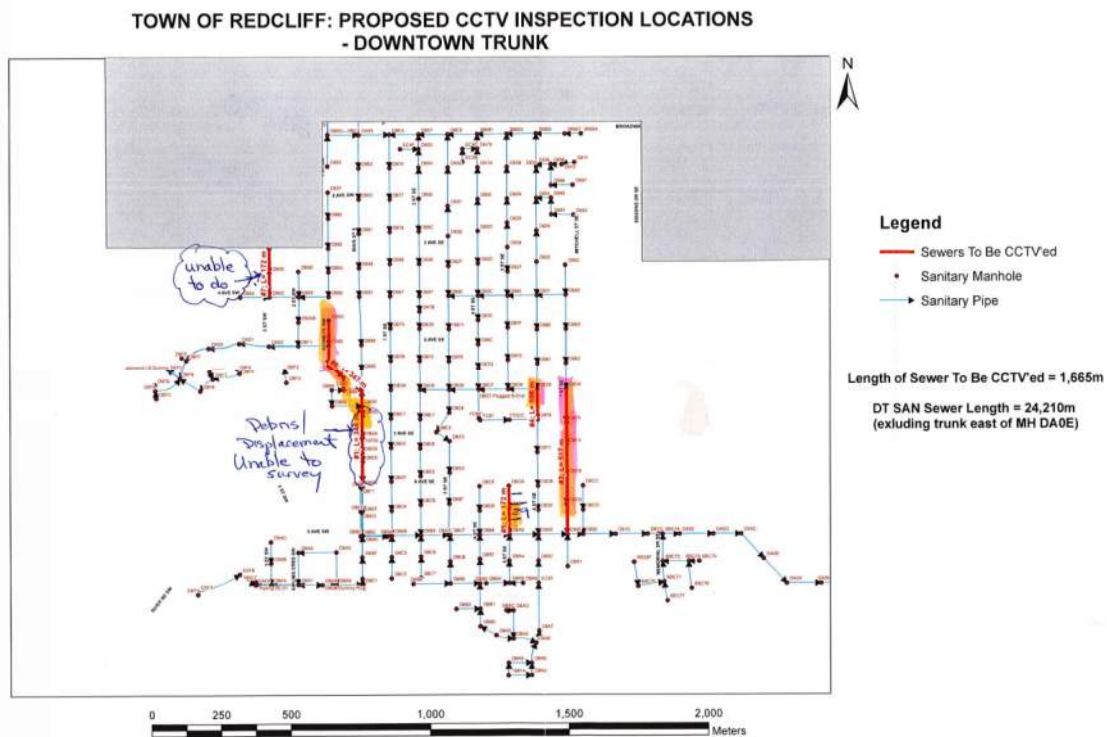


Figure 6.10 – Remainder of CCTV Inspections



CCTV findings included the following:

- Debris was encountered at numerous locations. This was most severe along Main Street, as well as along 4 Avenue NW. Other noteworthy locations include the gravity sewer through Broadfoot Place SW and downstream to where it crosses over towards Main Street. This has a capacity related impact, but not one related to inflow-infiltration.
- Encrustation was noted in numerous sewers, including the sewer along Stone Place SW, along 5 Street SE north of 9 Ave SE. Again, this has a capacity impact, but not an inflow-infiltration impact.
- A major sag was noted under Stone Place SW, while a moderate sag was noted just southeast of Broadfoot Place SW. Yet again, this has a capacity impact, but not an inflow-infiltration impact.
- Relatively significant flow (especially for dry conditions) was noted in the sewer under 4 Avenue NW west of 4 Street NW. This is noteworthy and warrants further investigation.
- A severe joint displacement was found under Main Street near 6 Avenue S. This could contribute to infiltration, but not likely in a significant way.
- A displaced manhole lid, as well as unsealed holes in the lid was noted at Sangster Crescent SW, just west of Main Street.

It is noted that severely degraded / cracked pipe was not noted on this survey. While many of the sewers were not in particularly good condition, the main issues were displacements, deformations, encrustation, debris, and sags. These issues do warrant remediation, but this would not really have any impact on inflow-infiltration rates. Accordingly, the CCTV inspection did not reveal any major sources of inflow-infiltration, though it did suggest there could be a significant contributor in the far NW that further investigation is warranted for.

#### **6.4 Possible Inflow-Infiltration Reduction Measures**

Based on the smoke testing, CCTV inspection, and resident surveys, a number of possible recommendations pertaining to inflow-infiltration reduction can be considered by the Town.

These include the following:

- Ensure all sanitary manholes in Town are sealed. This could have a moderate impact on sewer inflows.
- Consider a sewer relining program where sewers are found to be degraded, but not sagged. Sewers with sags would need replacement. This could have an impact on sewer infiltration, though the investigation results do not suggest it will be a large impact.
- Due to the difficulty in doing anything on private lots, consider a resident education campaign, encouraging residents to ensure that within their lots that:
  - Sump pumps do not discharge to the sanitary system
  - Roof leaders discharge to the ground surface
  - Positive drainage is maintained away from homes in case weeping tiles could be connected to the sanitary system.

A program like this could have a reasonable positive impact on the overall inflow-infiltration in Town, most specifically the South Trunk. Based on the findings, however, it does not really explain the northwest.

## 6.5 Areas for Further Review

Given the extreme observed runoff rates in the northwest, coupled with the calibrated model replicating (or exceeding these rates), as well as backups that have been noted in the area by the Town (not as readily reported by residents, as businesses in the area do not have basements to experience the backups), this is a primary candidate for further review. One would naturally ask what is different between the northwest and the rest of Town, particularly when the northwest sees worse inflow-infiltration than some older parts of Town. It is a logical, though at this point, unsupported supposition that the horticultural (i.e. greenhouse) development there could be a major contributor (though as a counterpoint, high rates are not seen in the north industrial area, despite it also having some horticultural development).

It is noteworthy that during discussions with the Town, it was felt that greenhouses in the northwest may have some sort of overflow system to the sanitary system from rainwater recycling systems. It is critical to note that no actual evidence that this is the case currently exists. It is further noted that during wet weather there is massive amounts of runoff fed to a largely surface drainage system off of the greenhouses. Looking at the hydrographs from the flow monitoring data suggests that there is a sharp response to rainfall in the northwest, consistent with an inflow problem. This is not to suggest that there is a direct feed into the sanitary system from a runoff connection, as in the flow monitoring period, there was at peak 1.66L/s/ha, when storm runoff would be more in the order of 70L/s/ha to 100L/s/ha. That said, it is not impossible that a small area, say one hectare or so (e.g. a single greenhouse) could have some sort of more direct connection.

It is therefore recommended that the Town install its flow monitors at select locations upstream of the lift station in 2015 and beyond to try and pinpoint the source of the higher wet weather flows. Possible locations include:

- 4 Street NW north of 3 Ave NW (isolates the north and east parts of the northwest)
- 5 Street NW and 3 Ave NW (isolates the west parts of the northwest)
- 4 Street NW south of 3 Ave NW (isolates the south parts of the northwest)
- 3 Street NW south of 3 Ave NW (though flows might be too low to measure here – it is also noted there is supposed to be flow logging leaving the factory area to this line, which might eliminate the need for a monitor here)
- 4 Ave NW around 1 Street NW or 2 Street NW (start splitting up the north and east parts of the northwest)
- 1 Street NE at 3 Ave NW (isolates the east part of the northwest)



## 7.0

## Existing System Upgrades

### 7.1 Level of Service Discussion

As noted in Section 5.0 above, the Town's existing wastewater collection system requires significant upgrades. To properly consider upgrades, however, it is necessary to select a level of service to meet with system performance. As presented previously, the two potential levels of service considered included the Huff storm, and the July, 2013 thunderstorm. Preliminarily speaking, it was felt that the Huff storm was felt to be more appropriate as a thunderstorm is typically excessive for sanitary level of service due to potential extreme runoff rates. That said, upgrades for each were developed and taken to Redcliff Town Council for a decision on December 8, 2014.

#### 7.1.1 Huff Storm Upgrades

Upgrades were developed for the 1:50 year, 24 hour Huff storm. These are conceptually shown on Figure 7.1. Upgrades include the South Trunk, many sewers in the northwest, lift station upgrades at Jesmond Lift Station (wet well capacity) and the 3 Street/3 Ave NW lift station (pump upgrades), and some minor trunk upgrades along 2 Street SE and in the Broadfoot Place SW to Sangster Crescent SW area (including connection of the downstream end of this to the existing 450mm sewer under Main Street instead of the 300/250mm sewer it is currently connected to).

Improved system performance in terms of HGL to ground and percent pipe utilization is shown on Figures 7.2 and 7.3, while a set of HGL profiles is provided in Figures 7.4.1 through 7.4.12. Nominal surcharge remains after the upgrades, as it was deemed that limited minor surcharge was acceptable versus increased costs. Cost estimates follow in 7.1.3.

Note that these upgrades assume the trunk sewer to Medicine Hat is twinned. Further discussion follows in Section 7.2.

#### 7.1.2 July 2013 Thunderstorm Upgrades

Upgrades were developed for the July, 2013 Thunderstorm. These are conceptually shown on Figure 7.5. Upgrades are very extensive. They include those from the Huff storm, plus

- Complete upgrades of the trunk under 1 Street SE
- Upgrading of the trunk sewers in the Jesmond Lift Station as well as the forcemain
- Even more extensive upgrading of sewers in the northwest
- Enhanced lift station pumping capacity at the Jesmond Lift Station
- A major capacity upgrade at the 3 Street/3 Ave NW Lift Station, as well as upgrades of the forcemain, the entire downstream trunk and the east trunk.
- Assorted additional trunk upgrades.

Improved system performance in terms of HGL to ground and percent pipe utilization is shown on Figures 7.6 and 7.7; HGL profiles were not prepared as results were similarly improved as to the

Huff Storm previously. Nominal surcharge remains after the upgrades, as it was deemed that limited minor surcharge was acceptable versus increased costs. Cost estimates follow in 7.1.3.

### 7.1.3 Comparative Cost Estimates

Cost estimates for each option were developed for discussion with Town Council. Either option presumed that the trunk sewer to Medicine Hat was upgraded, or an alternative flow management scenario was in place. Cost estimated developed are summarized in Table 7.1, with Tables 7.2 and 7.3 providing detail supporting these cost estimates.

Table 7.1 – Existing System Upgrade Cost Estimate Summary

Town of Redcliff Sanitary Upgrades - Cost Estimate Summary		
Proposed Sanitary Upgrades	Scenario (Existing System)	
	50-yr 24-hr 4th Quartile Huff Storm	July 6, 2013 Thunderstorm
Trunk Sewers	\$2,010,000	\$7,750,000
Forcemains	\$790,000	\$1,580,000
Lift Stations / Pumps	\$1,740,000	\$8,120,000
Pavement Rehabilitation	\$3,880,000	\$11,190,000
<b>Total Cost</b>	<b>\$8,420,000</b>	<b>\$28,640,000</b>

Note:

These estimates do not include the cost of upgrading the Medicine Hat sewer to provide adequate capacity to convey the Town's existing and future sanitary flows to Medicine Hat's WWTP.

Looking at the comparative costs, it is readily apparent that the Thunderstorm option represents an extreme upgrading scenario that is likely not sustainable. Based on this information and discussions with Town Council and Administration, the Town decided to adopt the 50 year, 24 Hour Huff storm as a level of service, so upgrades for conveyance capacity within Town will be based on that option.

## 7.2 Medicine Hat Trunk Sewer Capacity

The Town currently experiences major sewer backups, which assessment in Section 5.0 above has noted to be heavily related to capacity of the line to Medicine Hat. It is noted that flows reaching the sanitary gate may be up to 200L/s already, when the line has a capacity of around 170L/s. This has led to major backups along the South Trunk, and, in some cases, even surcharge to surface.

In Section 7.1 above, it was assumed that some a remedial measure is in place, most likely a trunk sewer upgrade to Medicine Hat. ISL has considered three remedial issues to this capacity in the short term (with other possible major system concept shifts discussed in Section 8.0 below):

- Twinning of the sewer to Medicine Hat





- Surge Suppression Lagoon to limit flows to capacity of the line to Medicine Hat
- Sub-surface storage option to limit flows to capacity of the line to Medicine Hat

### 7.2.1 Twinning Line to Medicine Hat

ISL identified that twinning the existing line with a 450mm sewer should provide some limited growth capacity, as well as dealing with existing capacity issues. Cost estimates were prepared and are estimated at \$2,740,000, as detailed in Table 7.4. Modelling with the twinned option is provided in 7.1 above.

It is strongly noted that this does not include any upgrades in Medicine Hat downstream. The City has not been forthcoming with what this would mean to their system. It could include any of the following:

- Off-Site Levy Charges
- Upgrading to the gravity sewers and lift station / forcemain in the Brier Park area
- Major conveyance upgrades to the City's wastewater treatment plant (these were suggested to exceed \$10,000,000 in capital value, with no indication what share Redcliff would be expected to carry though it was noted they are not in the City's 25 year capital plans (suggesting a major share could be expected to be front-ended by the Town)).

To allow for growth, this option could be upsized at a relatively nominal cost, perhaps in the order of \$500,000 for growth of 2,500 people, and up to \$1,000,000 for growth of 5,000 people.

Accordingly, this option has a moderate defined cost, but a potentially major undefined cost that could jeopardize its feasibility.

### 7.2.2 Surge Suppression Lagoon

ISL then reviewed a surge suppression lagoon to limit flows to the Medicine Hat outfall sewer's capacity. Through hydrodynamic modelling, the size of the lagoon was estimated at 6,400m<sup>3</sup> of active storage, with ancillary works including liner, general excavation (needs to be at the right elevation to avoid pumping), and control structures. ISL has estimated the cost of this lagoon to be \$600,000 for existing purposes only (no growth).

The concept for this is provided in Figure 7.8, with system performance shown in Figure 7.9 and 7.10, and HGL profiles provided in 7.11.1 through 7.11.12. This upgrade generates some minor tailwater in profiles 1, 7, and 8, as expected.

The main issue with this sort of open air option is setbacks from a sewage lagoon. It is expected that a minimum of 100m would be required for non-residential development (would require special permission from Alberta Environment), and a standard 300m setback would apply otherwise (and to residential development, regardless). The 300m setback would also apply to the distance to the City of Medicine Hat, to avoid sterilization of its land. Based on this, such a lagoon would likely sterilize much of the Eastside Area Structure Plan Area. Factoring in a cost of land at \$25,000/acre, this could sterilize in the order of \$2,000,000 worth of land. It is noted that this option would not require upgrades in the City of Medicine Hat, but would require expansion to facilitate growth.

The Town has indicated it does not have interest in this scenario as it sterilizes a short term growth area.

### 7.2.3 Sub-Surface Storage Option

ISL then reviewed sub-surface storage option to avoid the land sterilization. The size was estimated at the same 6,400m<sup>3</sup> as the surge lagoon. There are two possible configurations here:

- Reservoir style sub-surface tank storage
- Linear Box Section storage option (along South Trunk) – would require deep installation and lift station to get flows out to avoid backups (would be 2.4m vertically as a 3.0x2.4 box section)

Cost estimates for these options were developed as follows:

- Reservoir style tank storage - \$1,325/m<sup>3</sup> plus 30% contingency and 15% for engineering = \$12.2M
- Linear Box Section - \$11.4M (refer to Table 7.5 attached)

Both options would avoid upgrades in Medicine Hat and would eliminate land sterilization. That said, neither would provide for growth.

Given the significant costs and lack of growth accommodation, this option was not pursued further.

## 7.3 Existing System Upgrade Recommendations

There is discussion in Section 8.0 below covering a major shift in future wastewater servicing options for the Town. In the absence of this, if upgrades were sought in the short term, the following are recommended:

- Twin the sewer to Medicine Hat
- Negotiate costs for improvements required within Medicine Hat
- Move forward with in-Town conveyance upgrades once the conveyance to Medicine Hat is sorted out, starting with the South Trunk.
- Consider upgrades in the northwest, only after attempts to find and mitigate high wet weather flows are undertaken.





## 8.0 Future Wastewater Servicing Concepts

### 8.1 Future Growth Scenarios

Future growth scenarios were utilized as per the Wastewater System Evaluation (MPE, 2013), with growth in the following areas:

- Northside
  - 10ha of commercial development
  - 369ha of non-residential development
- Eastside
  - 4,247 persons over 143 ha of residential development
  - 33.5 ha of commercial development
- Westend
  - 55 lots over 20 ha of residential development
- Northend
  - 985 persons over 50 ha of residential development
  - 20 ha of horticultural development
- North Gateway
  - 25 ha of commercial development
- Bayliss
  - 10 ha of industrial development
  - 10 ha of horticultural development
- River Terrace
  - 2,400 persons over 100 ha of residential development

Largely, future scenarios focused on full build-out for conveyance, with facilities (e.g. treatment, etc.) staged at 2,500 and 5,000 person growth scenarios.

#### 8.1.1 Future Design Standards

Based on knowledge of flow rates in Town, ISL prepared future flow projections based on the following:

- Residential flow rate of 300L/p/d
- Residential peaking factor based on Harmon's formula
- Residential inflow-infiltration rate of 0.28L/s/ha consistent with Provincial standards (revision from previous study)
- Non-residential flow rates reduced from the previous study, but higher than calibrated rates as follows:
  - 12m<sup>3</sup>/ha/d for commercial
  - 4m<sup>3</sup>/ha/d for industrial
  - 10m<sup>3</sup>/ha/d for horticultural

- Alberta Environment non-residential peaking factor
- Non-residential inflow-infiltration rate of 0.1128L/s/ha

Table 8.1 – Future System Design Flow Rates

	Item	Scenario		
		Previous Study	Calibrated Rates	FINAL RATES
DWF Rate	Residential (L/p/d)	300	300	300
	Commercial (m³/ha/d)	17.28	6.00	12.00
	Industrial (m³/ha/d)	12.96	1.00	4.00
	Horticultural (m³/ha/d)	17.28	4.72	10.00
I-I Rate	Residential (L/s/ha)	0.16	0.28	0.28
	Non-Residential (L/s/ha)	0.10	0.28	0.1128

## 8.2 System Performance under Growth Conditions

Figures 8.1 and 8.2 show HGL to ground and pipe utilization if full growth is applied to the existing collection system, assuming the sewer to Medicine Hat is upgraded. HGL profiles are included in Figures 8.3.1 through 8.3.12 show HGL profiles.

The system has degraded from existing as expected. Particular degradation is noted in growth areas, particularly evident along the East Trunk into the North Industrial, along the South Trunk, and within the northwest and downstream from the lift station.

This feeds into future system upgrading scenarios.

## 8.3 Possible Future Wastewater Servicing Concepts

Effectively, there are a number of possible future servicing concepts for the Town. It is not possible to cover them in complete detail, given that some represent a major paradigm shift for the Town that would require extensive discussion to proceed with. That said, the following options are discussed in varying degrees of detail in sections below:

- Option 1A (MH – TWIN)
  - Upgrade Town conveyance systems as needed
  - Upgrade sewer to Medicine Hat as needed
  - Agree to fund necessary upgrades in Medicine Hat
- Option 1B (MH – L)
  - Use surge suppression lagoon in lieu of upgrading sewer to Medicine Hat and upgrading in the City



- Option 1C (MH – SS)
  - Use sub-surface surge suppression in lieu of upgrading sewer to Medicine Hat
- Option 2A (NP – L)
  - Move discharge from 3 Street / 3 Ave NW lift station to North Industrial
  - Revise in-Town upgrades based on this
  - Construct new sewage lagoon in north with outfall east to South Saskatchewan River
- Option 2B (NP – MBR)
  - Use new membrane bio-reactor (MBR) plant in lieu of sewage lagoon in north
- Option 3A (SE – MBR)
  - Construct new MBR plant in southeast, in Eastside ASP area
  - Construct new outfall sewer running south to South Saskatchewan River
  - Upgrade conveyance systems as needed
- Option 3B (S – MBR)
  - Construct new MBR plant south of Memorial Drive SE
  - Construct new outfall sewer running south to South Saskatchewan River
  - Upgrade conveyance systems as needed
- Option 3C (SW – MBR)
  - Construct new MBR plant down near river in the River Terrace area.
  - Construct new outfall sewer to the plan location from the South Trunk.
  - Construct new outfall to South Saskatchewan River.

Fundamentally, all of the options fall into one of two categories as it pertains to conveyance upgrades inside Town:

- Scenario 1 - Conveyance upgrades to SE corner of Town / Sanitary Gate (applies to 1A, 1B, 1C, 3A, 3B, 3C above)
- Scenario 2 - Variant with northwest pumped into north industrial area (applies to 2A, 2B above)

Beyond this, the remaining aspects are unique, consisting of either twinning or flow suppression where conveyance for growth is provided to Medicine Hat, or else a treatment scenario to provide growth capacity for the Town.

### 8.3.1 Baseline Conveyance Upgrade Considerations

To assist in evaluation of the scenarios above, conveyance based upgrades were developed.

#### Scenario 1 – Conveyance to SE Corner of Town / Sanitary Gate

First, upgrades were developed, presuming all flows proceed to the southeast corner of Town. To develop these conveyance upgrades, it was assumed that capacity restriction to Medicine Hat did not exist. Upgrades pertaining to this are discussed below.

These upgrades are shown on Figure 8.4. HGL relative to ground with upgrades in place is shown on Figure 8.5 with pipe utilization shown on Figure 8.6. HGL profiles are provided in Figures 8.7.1 through 8.7.12. Total costing is provided below.

#### Scenario 2 – Northwest Pumped into North Industrial Area with Alternative Outfall from North

Next, upgrades were developed, presuming an alternative outlet (i.e. treatment and outfall) would be provided in the north industrial area. This included pumping the northwest into the north industrial to help provide growth capacity for other areas in the west, south, and east by sending the existing northwest flows to the north, providing capacity for growth in the outfall sewer to Medicine Hat. In this case, the Medicine Hat sewer was left as it exists today as a test case.

It is noted that flows to the SE corner overwhelmed the Medicine Hat sewer, so a storage solution was provided to make this workable in the model, with a twinning option remaining on the table if this alternative were followed.

These upgrades are shown on Figure 8.8. HGL relative to ground with upgrades in place is shown on Figure 8.9 with pipe utilization shown on Figure 8.10. HGL profiles are provided in Figures 8.11.1 through 8.11.13. Total costing is provided below.

#### Conveyance Upgrade Cost Comparison

Ignoring any twinning, storage, or treatment options, conveyance costing is summarized in Table 8.2 below, with the detail for each provided in Tables 8.3 and 8.4 respectively.

Table 8.2 – Future System Upgrade Options – Conveyance (North Plant vs SE Sewer)

Town of Redcliff Sanitary Upgrades - Cost Estimate Summary		
Proposed Sanitary Upgrades	Future Ultimate System	
	Scenario 1	Scenario 2
Trunk Sewers	\$4,050,000	\$3,700,000
Forcemains	\$1,140,000	\$2,380,000
Lift Stations / Pumps	\$1,740,000	\$1,740,000
Pavement Rehabilitation	\$7,050,000	\$7,110,000
<b>Total Cost</b>	<b>\$13,990,000</b>	<b>\$14,930,000</b>

Note:

These estimates do not include the cost of upgrading the Medicine Hat sewer to provide adequate capacity to convey the Town's future sanitary flows to Medicine Hat's WWTP.

Beyond the conveyance upgrades, other items are required to make these workable.



### 8.3.2 Flow Management Options for Conveyance to City of Medicine Hat Upgrades or Flow Mitigation

As with existing system upgrade options, there are really three options to deal with increased flows leaving the Town destined for Medicine Hat

- Twinning of the sewer to Medicine Hat
- Surge Suppression Lagoon to limit flows to capacity of the line to Medicine Hat
- Sub-surface storage option to limit flows to capacity of the line to Medicine Hat

#### Twinning Line to Medicine Hat

ISL identified that twinning the existing line with a 675mm sewer should provide growth capacity to near build-out (i.e. beyond 10,000 people). Cost estimates were prepared and are estimated at \$3,504,000, as detailed in Table 8.5.

It is strongly noted that this does not include any upgrades in Medicine Hat downstream. The City has not been forthcoming with what this would mean to their system. It could include any of the following:

- Off-Site Levy Charges
- Upgrading to the gravity sewers and lift station / forcemain in the Brier Park area
- Major conveyance upgrades to the City's wastewater treatment plant (these were suggested to exceed \$10,000,000 in capital value, with no indication what share Redcliff would be expected to carry though it was noted they are not in the City's 25 year capital plans (suggesting a major share could be expected to be front-ended by the Town)).

Accordingly, this option has a moderate defined cost, but a potentially major undefined cost that could jeopardize its feasibility.

#### Surge Suppression Lagoon

This option was ruled out for existing system upgrades due to sterilization of the Eastside ASP lands. That said, it was revisited, only insofar as to make the North Offload Scenario work. It was estimated at around 30,000m<sup>3</sup> in volume at a cost of around \$2.0M. As previously, this was not deemed promising by the Town due to the sterilization of lands in the Eastside ASP.

#### Sub-Surface Storage

This option was ruled out for existing upgrades due to its extreme cost. Given the near 30,000m<sup>3</sup> of volume required, a linear style option simply will not work, as it would take over 3km of 3.0m x 3.0m box culvert. If a tank type option were pursued, it would cost over \$1,000/m<sup>3</sup>, putting the cost in excess of \$30,000,000, which is simply not feasible.

#### SE Lift Station Scenario

A lift station at the SE corner was also reviewed. This was considered for both future Scenario 1 and future Scenario 2.

Scenario 1 would be a case where all conveyance was upgraded to the SE corner, but a north lagoon or treatment plant was being considered, and all flows in excess of the existing line

capacity would be pumped north to this plant. This is costed out in Table 8.6, with an estimated cost of \$12,300,000 (lift station and forcemain).

### 8.3.3 Treatment Options

In any of the variants where treatment is contemplated, it is necessary to develop costing for various treatment options. For the purposes of this analysis, a conventional (anaerobic/facultative/storage) lagoon system constructed under the Alberta Environment Code or Practice, and a Membrane Bio-Reactor (MBR) treatment plant, representing best practicable technology with a low footprint are being considered at this stage.

#### Conventional Lagoon System

For high level estimation purposes, it is presumed that a conventional treatment system would need to treat average flows of around 1,000m<sup>3</sup>/day for growth of 2,500 persons, and 2,000m<sup>3</sup>/day for growth of 5,000 persons. Based on the code of practice necessitating residence times of 8 days in anaerobic cells, 60 days in facultative cells, and 365 days in storage cells, volumes and estimated costs are summarized as follows:

- **2,500 growth**
  - 8,000m<sup>3</sup> of anaerobic cells at \$30/m<sup>3</sup> = \$240,000
  - 60,000m<sup>3</sup> of facultative cells at \$20/m<sup>3</sup> = \$1,200,000
  - 365,000m<sup>3</sup> of storage cells at \$12/m<sup>3</sup> = \$4,400,000
  - Land Area, averaging 2m storage depth = 22 hectares (~470m square) @ \$25,000/acre = \$1,370,000
  - Additional sterilized land area with 100m setback (presuming granted by Alberta Environment) = 23 hectares (670m square less working area) @ \$25,000/acre = \$1,440,000
  - Additional sterilized land area with 300m setback = 92 hectares (1070m square less working area) @ 25,000/acre = \$5,750,000
  - **Total cost = \$8,650,000 to \$12,960,000**
- **5,000 growth**
  - 16,000m<sup>3</sup> of anaerobic cells at \$28/m<sup>3</sup> = \$448,000
  - 120,000m<sup>3</sup> of facultative cells at \$18/m<sup>3</sup> = \$2,160,000
  - 730,000m<sup>3</sup> of storage cells at \$11/m<sup>3</sup> = \$8,030,000
  - Land Area, averaging 2m storage depth = 43 hectares (~660m square) @ \$25,000/acre = \$2,688,000
  - Additional sterilized land area with 100m setback (presuming granted by Alberta Environment) = 31 hectares (860m square less working area) @ \$25,000/acre = \$1,938,000
  - Additional sterilized land area with 300m setback = 116 hectares (1260m square less working area) @ 25,000/acre = \$7,250,000
  - **Total cost = \$15,264,000 to \$20,576,000**

#### MBR Plant



ISL is currently working on a number of MBR plants and cost estimates were established based on those projects. Footprints of plants are taken at 50m x 50m for the 2,500 scenario, and 100m x 100m for the 5,000 scenario. Cost estimates for a greenfield installation are established on this basis as follows:

- **2,500 growth**

- Estimated plant cost - \$5,000,000
- Land Area = 0.25 hectares (50m square) @ \$25,000/acre = \$16,000
- Additional sterilized land area with 100m setback (presuming granted by Alberta Environment) = 6 hectares (250m square less working area) @ \$25,000/acre = \$375,000
- Additional sterilized land area with 300m setback = 42 hectares (650m square less working area) @ 25,000/acre = \$2,625,000
- **Total cost = \$5,391,000 to \$7,641,000**

- **5,000 growth**

- Estimated plant cost - \$9,800,000
- Land Area = 1.0 hectares (100m square) @ \$25,000/acre = \$62,500
- Additional sterilized land area with 100m setback (presuming granted by Alberta Environment) = 8 hectares (300m square less working area) @ \$25,000/acre = \$500,000
- Additional sterilized land area with 300m setback = 48 hectares (700m square less working area) @ 25,000/acre = \$3,000,000
- **Total cost = \$10,362,000 to \$12,862,000**

### 8.3.4 North Lagoon or WWTP Alternatives – Outfall Sewers

If a lagoon or wastewater treatment plant were to be located in the north, an outfall sewer would be needed east to the South Saskatchewan River. It is presumed an alignment running roughly due east would be feasible.

If a lagoon were developed, the outfall would need to drain the storage lagoon in within 3 to 6 weeks (subject to Alberta Environment's discretion). For the purposes of costing, a 525mm sewer was employed, at an estimated cost of \$4,885,000 was developed, as detailed in Table 8.8.

If a WWTP were developed, the outfall would only need to deal with maximum monthly average daily design flows. An estimate, for a 450mm pipe, was determined to be \$4,375,000, as detailed in Table 8.9. (Note this presumes flows from the southeast are not pumped north).

### 8.3.5 South WWTP Alternatives – New Trunk Sewers and Outfall Sewers

As noted above, three different locations for a south plant were considered. There is insufficient land available in the south for a sewage lagoon, while also not sterilizing land in the City of Medicine Hat (which is considered a non-starter). Figure 8.13 as inset below shows three possible plant locations, along with possible sewers from each location (noting that due to the



escarpment, detailed study is required to set an alignment for each. Locations are generally selected to allow 300m setbacks to any development or the City of Medicine Hat.



Figure 8.13 – Possible South WWTP Locations

#### **Southeast WWTP**

An outfall sewer (675mm) would proceed west and then south to the South Saskatchewan River. It is assumed to be largely open cut, with trenchless required down the escarpment (with feasibility and route to be determined through a more detailed investigation). Costing is estimated at \$3,849,000, as detailed in Table 8.10. This would take all flows in excess of the capacity to Medicine Hat.

#### **South WWTP**

A collector sewer (600mm) would proceed from the Redcliff Way / 9 Ave SE intersection to the plant site (presumed to be open cut). From here a 600 mm outfall sewer would proceed south to the South Saskatchewan River. It is assumed to effectively all trenches down the escarpment (with feasibility and route to be determined through a more detailed investigation). Costing is estimated at \$3,742,000, as detailed in Table 8.11. This would take all flows from the South Trunk, leaving growth capacity in the line to Medicine Hat for development in the north.

#### **South WWTP**

A collector sewer (600mm) would proceed from the Redcliff Way / 9 Ave SE intersection through the golf course to the edge of the escarpment (presumed to be open cut, with golf course rehabilitation factored in). From here the sewer would proceed southwest to the WWTP site (located above the floodplain). It is assumed to effectively all trenches down the escarpment (with feasibility and route to be determined through a more detailed investigation). A short outfall





sewer would be constructed after the plant. Costing is estimated at \$3,736,000, as detailed in Table 8.12. This would take all flows from the South Trunk, leaving growth capacity in the line to Medicine Hat for development in the north.

#### **8.4 Assessment of Wastewater Servicing Concepts**

The future scenarios were reviewed for feasibility. Table 8.13 details this discussion. Comparison was done for growth of 2,500 persons, given this is the highest unit cost step. Based upon this, 5 of the 8 scenarios were deemed feasible, those being:

- 1A (MH-TWIN)
- 1B (MH-L)
- 3A (SE-MBR)
- 3B (S-MBR)
- 3C (SW-MBR)

From this, further review was undertaken on the five feasible options. This discussion is captured in Table 8.14. Three different categories of recommendation were made for the options as follows:

- Option Dropped
  - 3A (SE-MBR)
- Town must determine if Eastside ASP sterilization is palatable
  - 1B (MH-L) – if palatable, Town must discuss if a surge lagoon is workable or not
  - 3B (S-MBR) – if palatable, plant feasibility assessment should be undertaken as well as a feasibility assessment on the outfall sewer
- Best options – review further
  - 1A (MH-TWIN) – continue discussions with City to determine capital costs of upgrades / connection fees to City system. Re-visit costing of this option once this is known. If upgrade costs in Medicine Hat are <\$5,000,000, this is likely the preferred option.
  - 3C (SW-MBR) – start a feasibility assessment for the MBR plant as well as the outfall alignment in the near future. This could be delayed until more information is available from the City on option 1A (MH-TWIN). If City wants more than \$5,000,000 or so from the Town, this becomes the preferred option).





## 9.0 Conclusions and Recommendations

The Inflow-Infiltration Study / Wastewater Master Plan Update was prepared to achieve the following objectives:

1. To develop a hydrodynamic model of the Town's existing wastewater collection system and calibrate it to provide accurate capacity assessment.
2. To use the calibrated model to prepare capacity assessment of the existing wastewater servicing system and its ability to perform under existing and growth conditions.
3. To determine what, if any, upgrades for existing Town infrastructure are required to meet servicing objectives under existing conditions
4. To review existing inflow-infiltration rates observed under wet weather conditions.
5. To review possible sources of inflow-infiltration and recommend remedial measures.
6. To determine what, if any, upgrades for existing City infrastructure are required to meet servicing objectives under future growth scenarios to a population of 10,000.
7. To provide a framework for future wastewater capital planning.
8. To provide costs related to infrastructure requirements.
9. To comment on possible staging of infrastructure and/or growth areas, where applicable.

This framework should provide a "road map" for the Town to follow to ensure sound wastewater system planning.

### 9.1 Conclusions

Conclusions for the the Study are as follows:

- 1) The Town's wastewater collection system performs adequately under the Alberta Environment 0.28L/s/ha event.
- 2) A 1:50 year, 24 hour, 4<sup>th</sup> quartile Huff storm was selected as a level of service, given it gave reasonable replication of sewer backup issues in the Town.
- 3) The July, 2013 thunderstorm was deemed excessively conservative for a level of service.
- 4) The major constraints in the Town's wastewater collection system include:
  - a. Outfall Sewer to Medicine Hat capacity – this is the primary contributor to sewer backups
  - b. South Trunk sewer capacity
  - c. Northwest lift station (3 Street / 3 Ave NW) as well as select sewer capacity.
- 5) Inflow-infiltration rates in the Town's system can be summarized as follows:
  - a. Northwest – extreme rates that are very unusual
  - b. South Trunk – elevated rates typical for an older system
  - c. North Industrial – limited inflow-infiltration noted
- 6) Surveys of Town residents noted some items on private lots that could be contributing to inflow-infiltration in the Town. This primarily included sump pumps and some roof leaders. It is noted that this was primarily within the South Trunk catchment.
- 7) Smoke testing did not reveal any major contributors to inflow-infiltration. Some manholes were found to be unsealed.
- 8) CCTV inspection did not reveal any major contributors to inflow-infiltration. It did reveal some deficiencies and debris that could cause capacity constraints.

- 9) There are no obvious causes of the high inflow-infiltration rates in the northwest, so further investigation is required.
- 10) Upgrades are needed to the existing collection system, but decisions on the ultimate servicing plans for the Town must be made to ensure throwaway costs are not incurred.
- 11) It is paramount to get a handle on the upgrade/connection costs in the City of Medicine Hat to be able to establish the proper way forward for the Town in order to act in a fiscally prudent manner.
- 12) There is little to no growth capacity in the Town's system until upgrades are in place either to the City of Medicine Hat, or to a "made in Redcliff" solution.
- 13) Discussions around the Town's preferences for future servicing are required.

## 9.2 Recommendations

Recommendations for the Study are as follows:

- 1) To reduce inflow-infiltration in the Town, the following are recommended:
  - a. Ensure all manholes are sealed
  - b. Consider a sewer relining program for older sewers where replacement is not required
  - c. Develop an education program to encourage residents to:
    - i. Disconnect sump pumps from the sanitary system
    - ii. Direct roof leaders onto the ground surface
    - iii. Ensure positive drainage away from their homes to reduce flows to weeping tiles.
- 2) Undertake additional flow monitoring in 2015 and beyond within the northwest to try and pinpoint sources of inflow-infiltration. Possible monitoring locations include:
  - a. 4 Street NW north of 3 Ave NW (isolates the north and east parts of the northwest)
  - b. 5 Street NW and 3 Ave NW (isolates the west parts of the northwest)
  - c. 4 Street NW south of 3 Ave NW (isolates the south parts of the northwest)
  - d. 3 Street NW south of 3 Ave NW (though flows might be too low to measure here – it is also noted there is supposed to be flow logging leaving the factory area to this line, which might eliminate the need for a monitor here)
  - e. 4 Ave NW around 1 Street NW or 2 Street NW (start splitting up the north and east parts of the northwest)
  - f. 1 Street NE at 3 Ave NW (isolates the east part of the northwest)
- 3) Before undertaking any existing system upgrades, the Town should:
  - a. Undertake the further flow monitoring in the northwest to see if reduction measures could be successful prior determine its future plans.
  - b. Establish upgrade and connection costs in the City of Medicine Hat for additional flow rates from 200L/s to 500L/s so that a proper cost comparison can be undertaken with other options.
  - c. Undertake a discussion to answer the following questions:
    - i. Is the Town comfortable having its growth plans constrained by the City of Medicine Hat?
    - ii. Is the Town willing to consider an option where the Eastside ASP lands are sterilized?
    - iii. Is the Town willing to construct a wastewater treatment facility to facilitate growth?



- d. Once these costs are established and questions answered, update the option analysis in this report.
- 4) This sets one of three paths forward for recommendations:
  - a. If proceeding to service to Medicine Hat:
    - i. Twin sewer to Medicine Hat
    - ii. Twin South Trunk sewer
    - iii. If inflow-infiltration reduction in northwest is not successful, proceed with upgrades in that area.
    - iv. Undertake other minor conveyance upgrades within Town
  - b. If proceeding with surge lagoon option:
    - i. Construct surge lagoon in Eastside ASP area
    - ii. Twin South Trunk Sewer
    - iii. If inflow-infiltration reduction in northwest is not successful, proceed with upgrades in that area.
    - iv. Undertake other minor conveyance upgrades within Town
  - c. If proceeding with an MBR plant option:
    - i. Undertake feasibility assessment for MBR plant
    - ii. Undertake feasibility assessment for sewers down escarpment for option 3B and 3C
    - iii. If feasibility assessments are positive, undertake construction of MBR plant and related sewer works. (South Trunk will not require twinning)
    - iv. If inflow-infiltration reduction in northwest is not successful, proceed with upgrades in that area.
    - v. Undertake other minor conveyance upgrades within Town





## 10.0 References

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Stantec Consulting Ltd. 2007. Eastside Functional Servicing Report.







## **Appendix A**

### Model Files







## **Appendix B**

### Smoke Testing Investigation Results





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Final Report for:  
The Town of Redcliff, Alberta

Attn: Mr. Geoffrey Schulmeister, P.Eng.

The Town of Redcliff, Alberta  
Sewer Smoke Testing 2014

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Prepared and submitted by:

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October 28, 2014

**ISL Engineering and Land Service Ltd.**

#1, 6325 – 12<sup>th</sup> Street SE.

Calgary, AB. T2H 2K1

Attn: Mr. Geoffrey Schulmeister

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**FINAL REPORT: SFE PROJECT # A14-135 – TOWN OF REDCLIFF - SANITARY SEWER SMOKE TESTS**

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Dear Sir,

Please find enclosed SFE's Final Report for the above mentioned project. Once you have had a chance to review the report please contact me directly with any comments or questions you may have.

Although we encourage our clients not to print reports that can be utilized digitally, please feel free to let us know if you require hard copies. Thank you for having SFE conduct this work on your behalf. We appreciate the business.

Sincerely,  
**SFE Global**

Nick Schellenberg  
General Manager, Prairies  
(204) 999-3547  
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## TABLE OF CONTENTS

### Section 1

Introduction.....	1
-------------------	---

### Section 2

2.1 Smoke Testing Procedures .....	1
2.2 Smoke Testing Incidents.....	2

### Section 3

QA/QC and Safety .....	2-3
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### Section 4

Conclusion .....	4
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### Appendices

- Appendix 1 – Maps
- Appendix 2 – Smoke Test Run Reports
- Appendix 3 – Smoke Test Incident Reports

## 1. Introduction

SFE was retained by the Town of Redcliff, under the direction of Mr. Geoffrey Schulmeister, P.Eng. to provide consulting, technical services and equipment related to Sanitary Sewer Smoke Testing of the Town of Redcliff, Alberta.

All smoke testing was conducted on August 19<sup>th</sup>, 20<sup>th</sup>, 26<sup>th</sup> to 29<sup>th</sup>, and September 10<sup>th</sup> and 11<sup>th</sup> 2014. This final report provides details of the tests conducted by SFE and all incidents whereby smoke was observed, or not observed in each area are outlined in Appendix 2. Mr. Nick Schellenberg from SFE acted as Project Manager for this project.

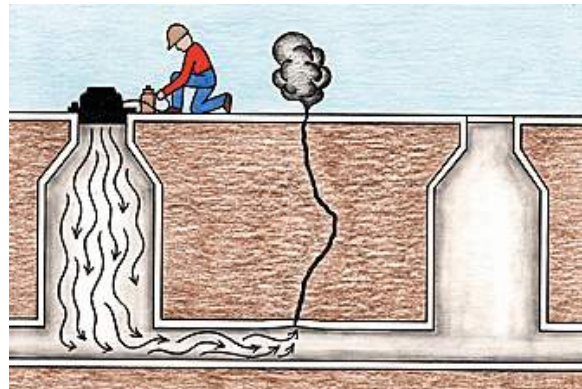
## 2. Smoke Testing

### 2.1 Smoke Testing Procedures

Smoke testing is one of the most efficient and cost effective methods of locating sources of inflow and infiltration (I&I) problems within sanitary sewers.

The non-toxic “smoke” will help find locations where storm and other sources of rain water enter the sanitary sewers. It is conducted by placing a blower over a centrally located manhole and forcing non-toxic smoke into the sanitary sewer line. As the air inside the sewer is pressurized, the smoke will fill the main line plus any and all connections. The smoke will then follow the path of any leaks to the ground’s surface, quickly revealing the source of inflow and infiltration (I&I).

The smoke will be noticeable wherever there is a leak in a sanitary sewer pipe, such as a crack in a sewer pipe, a cross-connection between a storm sewer and a sanitary sewer, where a roof drain is connected to the sanitary sewer, from a broken cleanout cap, or from a defective or damaged manhole.





## 2.2 Smoke Test Incidents

All smoke test run reports are included as Appendix 1 of this report. All smoke observation incident report locations are included as Appendix 2. A smoke test incident is an occurrence whereby smoke is observed emanating from a particular fixture or area.

## 3. QA/QC and Safety Statement

SFE confirms that all pipeline runs were smoke tested according to industry standards and SFE's QA/QC methodology and protocol, and standard industry practice. All equipment has been removed from the site locations.

SFE has a comprehensive Company Safety Manual and can be reviewed upon request.

Where required, confined space entry procedures and general site/traffic safety was adhered to during site installation and site maintenance. SFE utilizes the "DBI SALA" rescue system, a 2800 CFM air induction device and MSA air quality monitors. All of our staff members are thoroughly trained and certified in confined space entry procedures. Certificates are available upon request.

Where required, a thorough traffic control plan was established and used by SFE Global crews. All SFE crews and vehicles are outfitted with high visibility traffic safety equipment.

A pre-job safety inspection and meeting was conducted by SFE personnel and the following potential hazards were identified:

- Need for Personal Protective Equipment
- Traffic Control Requirements
- Heavy Lifting

This project was conducted in accordance with the WCB and OSHA safety standards as documented in SFE's Safety Procedures Manual. Local emergency response procedures were reviewed. A "tail-gate" meeting was conducted by SFE to review work to be completed and the hazards present prior to this work.

## Quality Assurance and Quality Control Procedures:

- All Field Crews are supplied with SFE smoke test field sheets for documentation of pertinent information.
- All Field Crews are supplied with legible City maps detailing the sewer lines, manhole numbers and street names.
- Pre-planning shall include an outline of runs laid out on the map with smoke induction and run end manholes noted.
- All incidents are detailed on the field sheets by the SFE crew foreman and shall include addresses, photos, GPS coordinates (decimal degrees), incident description, etc.
- All data entry into the SFE Smoke Testing software shall be conducted by SFE Data Processing.
- The smoke test final report shall include report body, smoke test run details, incident details and locations, maps detailing runs and if requested, raw databases for GIS.
- As a minimum 10% of the incidents shall be checked for a correlation between the incident location (i.e. address, street location) and the GPS coordinates. The SFE project manager (PM) shall ensure checks and balances are conducted for 10% of all readings. If mistakes are discovered, all incidents shall be checked by the PM.
- As a minimum, a PDF version of the final report shall be supplied to the client and printed only upon their request.

## 4. Conclusion

The sanitary sewer smoke test, conducted by SFE, has determined that there are several locations whereby storm and/or rain water is entering the Redcliff system. All incidents are detailed in Appendix 2 of this report.

The following is a legend for terms utilized on the Incident Reports:

<b>LEAK TYPE</b>	
<b>Codes</b>	<b>Definition</b>
RWL	Rain Water Leader – Down spout
MHC	Manhole Cover
CB	Catch Basin
SC	Service Connection
DT	Drain Tile
SPD	Swimming Pool Drain
CCD	Cleanout cap Defective
CCM	Cleanout cap Missing
CCB	Cleanout cap Broken
SI	Smoke Inside Building
NS	No Smoke from Main Vent
O	Other - Specify
<b>LEAK SURFACE COVER</b>	
<b>Codes</b>	<b>Definition</b>
A	Asphalt Street
B	Building Movable
D	Sidewalk
E	Tress & Shrubs
G	Gravel Area
L	Asphalt Lane
N	Non Movable Structure
R	Rail Road
T	Landscaped Area
BLVL	Landscaped Boulevard
BLVU	Unlandscaped Boulevard
<b>LEAK SOURCE</b>	
<b>Codes</b>	<b>Definition</b>
S	Service Connection
M	Main Sewer
ST	Storm Sewer
SD	Storm Water Ditch

Potential I&I	
Codes	Definition
0-1	Minimal
2-3	Low
4-5	Moderate
6-7	High
8-9	Very High

Should you have questions or comments please contact Nick Schellenberg at SFE Global (204) 999-3547.

Report End  
September 2014

SFE Global  
Project A14-135

## **Appendix 1**

### **Smoke Test Run Reports**

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 1      **Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	EA3	50.06246	-110.79752
<b>Run End Manhole:</b>	D9AA	50.06262	-110.79380

**Comments:** No incidents this run

**Run:** 2      **Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9AC	50.06398	-110.79380
<b>Run End Manhole:</b>	D9A8	50.06259	-110.79122

**Comments:** No incidents this run - No Smoke from: 106, 110, 202, 210, 214, 302 Redcliff Way SW

**Run:** 3      **Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9A9	50.06260	-110.79243
<b>Run End Manhole:</b>	D9A7	50.06260	-110.79043

**Comments:** No incidents this run - No Smoke from: 934, 942, 946 Kipling Crescent SW

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 4

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9A9	50.06260	-110.79243
<b>Run End Manhole:</b>	D8BE	50.06417	-110.78920

**Comments:** 1 incident this run - No Smoke from: 910, 914, 918, 922 Main Street S.

**Run:** 5

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8BE	50.06417	-110.78920
<b>Run End Manhole:</b>	D8EC	50.06506	-110.78923

**Comments:** No incidents this run.

**Run:** 6

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8F2	50.06574	-110.78923
<b>Run End Manhole:</b>	D8BD	50.06416	-110.78928

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 7

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8DC"/>	50.06880	-110.78930
<b>Run End Manhole:</b>	<input type="text" value="D8EB"/>	50.06546	-110.78920

**Comments:** No incidents this run.

**Run:** 8

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D99D"/>	50.06925	-110.79020
<b>Run End Manhole:</b>	<input type="text" value="D8DC"/>	50.06880	-110.78930

**Comments:** No incidents this run.

**Run:** 9

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8DC"/>	50.06880	-110.78930
<b>Run End Manhole:</b>	<input type="text" value="D957"/>	50.07193	-110.78929

**Comments:** No incidents this run.



## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 10

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D95D	50.07123	-110.79098
<b>Run End Manhole:</b>	D99D	50.06925	-110.79020

**Comments:** No incidents this run.

**Run:** 11

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D955	50.07189	-110.79228
<b>Run End Manhole:</b>	DA02	50.07034	-110.79386

**Comments:** No incidents this run. (Additional MH #D966)

**Run:** 12

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9FA	50.06886	-110.79954
<b>Run End Manhole:</b>	D9F6	50.06946	-110.79685

**Comments:** No incidents this run. (Additional MH #DEF2)  
No Smoke from 513 Jesmond Drive.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 13

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9FE	50.06999	-110.79830
<b>Run End Manhole:</b>	DA02	50.07034	-110.79386

**Comments:** 1 incident this run - No Smoke from 325, 520, 522 5th Avenue SW

**Run:** 14

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9F3	50.06910	-110.79302
<b>Run End Manhole:</b>	D9F7	50.06917	-110.79066

**Comments:** No incidents this run (Additional MH #D9F5)

**Run:** 15

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8A7	50.06108	-110.78034
<b>Run End Manhole:</b>	IB814	50.05967	-110.78197

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 16

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8AC	50.06194	-110.78191
<b>Run End Manhole:</b>	D8B0	50.06124	-110.78333

**Comments:** No incidents this run.

**Run:** 17

**Date:** August 26, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8B3	50.06262	-110.78331
<b>Run End Manhole:</b>	D8B2	50.06194	-110.78455

**Comments:** 1 incident this run.

**Run:** 18

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8A7	50.06108	-110.78034
<b>Run End Manhole:</b>	D8A3	50.06417	-110.78038

**Comments:** No incidents this run - No Smoke from 905 6th St SE

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 19

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8A6	50.06264	-110.78114
<b>Run End Manhole:</b>	D8B4	50.06257	-110.78303

**Comments:** No incidents this run (Additional MH #D8A0)  
No Smoke from 909, 914 5th Street SE

**Run:** 20

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8CF	50.06416	-110.78481
<b>Run End Manhole:</b>	D8B6	50.06260	-110.78661

**Comments:** No incidents this run - No Smoke from 308, 312, 316 Redcliff Way SW & 919, 915 3rd Street SE

**Run:** 21

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D957	50.07193	-110.78929
<b>Run End Manhole:</b>	D962	50.07503	-110.78930

**Comments:** No incidents this run - No smoke from Memorial Manor, 205 Main Street S.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 22

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D962	50.07503	-110.78930
<b>Run End Manhole:</b>	D9EA	50.07703	-110.78622

**Comments:** No incidents this run (Additional MH #D9BD)

**Run:** 23

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D968	50.07296	-110.78779
<b>Run End Manhole:</b>	D9EA	50.07703	-110.78622

**Comments:** 1 incident this run.

**Run:** 24

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D967	50.07191	-110.78776
<b>Run End Manhole:</b>	D8DA	50.06886	-110.78771

**Comments:** 1 incident this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 25

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8E1	50.06793	-110.78774
<b>Run End Manhole:</b>	D8BB	50.06416	-110.78773

**Comments:** No incidents this run.

**Run:** 26

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8C2	50.06278	-110.78782
<b>Run End Manhole:</b>	D8BE	50.06417	-110.78920

**Comments:** No incidents this run. (Additional MH #D8B9)

**Run:** 27

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8BB	50.06416	-110.78773
<b>Run End Manhole:</b>	D8B9	50.06418	-110.78627

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 28

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8C5"/>	50.06514	-110.78621
<b>Run End Manhole:</b>	<input type="text" value="D8CF"/>	50.06416	-110.78481

**Comments:** No incidents this run.

**Run:** 29

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8D9"/>	50.06881	-110.78626
<b>Run End Manhole:</b>	<input type="text" value="D8C5"/>	50.06514	-110.78621

**Comments:** No incidents this run.

**Run:** 30

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8D9"/>	50.06881	-110.78626
<b>Run End Manhole:</b>	<input type="text" value="D937"/>	50.07215	-110.78637

**Comments:** No incidents this run. No smoke from 439, 526 2nd Street.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 31

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D937	50.07215	-110.78637
<b>Run End Manhole:</b>	D933	50.07668	-110.78629

**Comments:** No incidents this run.

**Run:** 32

**Date:** August 27, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9EF	50.07668	-110.78633
<b>Run End Manhole:</b>	D935	50.07509	-110.78621

**Comments:** No incidents this run.

**Run:** 33

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9EA	50.07703	-110.78622
<b>Run End Manhole:</b>	D931	50.07475	-110.78483

**Comments:** No incidents this run. (Additional MH# 398B1)



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## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 34

**Date:** August 28, 2014

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		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="15611"/>	50.07083	-110.78478
<b>Run End Manhole:</b>	<input type="text" value="D931"/>	50.07475	-110.78483

**Comments:** 3 incidents this run. (Additional MH # D92C)

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**Run:** 35

**Date:** August 28, 2014

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		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D976"/>	50.06759	-110.78484
<b>Run End Manhole:</b>	<input type="text" value="D8E2"/>	50.06748	-110.78547

**Comments:** 1 incident this run. No smoke 613, 615, 617 3rd Street (Additional MH #D8D9, #D8D7)

---

**Run:** 36

**Date:** August 28, 2014

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		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8E2"/>	50.06748	-110.78547
<b>Run End Manhole:</b>	<input type="text" value="D8CE"/>	50.06414	-110.78486

**Comments:** No incidents this run.

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## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 37

**Date:** August 28, 2014

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		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	EC4B	50.07619	-110.78405
<b>Run End Manhole:</b>	398B1	50.07708	-110.78338

**Comments:** No incidents this run. (Additional MH #DA7A)

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**Run:** 38

**Date:** August 28, 2014

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		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	DA7A	50.07599	-110.78301
<b>Run End Manhole:</b>	D92C	50.07188	-110.78319

**Comments:** No incidents this run.

---

**Run:** 39

**Date:** August 28, 2014

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		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D92C	50.07188	-110.78319
<b>Run End Manhole:</b>	D8D7	50.06878	-110.78350

**Comments:** No incidents this run. No smoke 418 4th Street.

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## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 40

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8F6	50.06780	-110.78030
<b>Run End Manhole:</b>	D8D7	50.06878	-110.78350

**Comments:** No incidents this run.

**Run:** 41

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D929	50.07416	-110.78183
<b>Run End Manhole:</b>	398B1	50.07708	-110.78338

**Comments:** No incidents this run. (Additional MH #398B5)

**Run:** 42

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D929	50.07416	-110.78183
<b>Run End Manhole:</b>	D97F	50.07088	-110.78187

**Comments:** No incidents this run. No smoke from 307, 318, 325 5th Street.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 43

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D920	50.07191	-110.77890
<b>Run End Manhole:</b>	D92C	50.07188	-110.78319

**Comments:** No incidents this run.

**Run:** 44

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D97F	50.07088	-110.78187
<b>Run End Manhole:</b>	D8D5	50.06875	-110.78036

**Comments:** No incidents this run. No smoke from 420 6th Avenue. (Additional MH #D8D7)

**Run:** 45

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D8A3	50.06417	-110.78038
<b>Run End Manhole:</b>	D8F6	50.06780	-110.78030

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 46

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8CA"/>	50.06569	-110.78186
<b>Run End Manhole:</b>	<input type="text" value="D8A0"/>	50.06420	-110.78182

**Comments:** No incidents this run.

**Run:** 47

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8C9"/>	50.06571	-110.78333
<b>Run End Manhole:</b>	<input type="text" value="D8B8"/>	50.06418	-110.78324

**Comments:** No incidents this run.

**Run:** 48

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8CF"/>	50.06416	-110.78481
<b>Run End Manhole:</b>	<input type="text" value="D8A0"/>	50.06420	-110.78182

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 49

**Date:** August 28, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8B8"/>	50.06418	-110.78324
<b>Run End Manhole:</b>	<input type="text" value="D8B3"/>	50.06262	-110.78331

**Comments:** No incidents this run.

**Run:** 50

**Date:** August 29, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D921"/>	50.07295	-110.78042
<b>Run End Manhole:</b>	<input type="text" value="D981"/>	50.06975	-110.78035

**Comments:** No incidents this run.

**Run:** 51

**Date:** August 29, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D980"/>	50.07196	-110.78037
<b>Run End Manhole:</b>	<input type="text" value="D8F6"/>	50.06780	-110.78030

**Comments:** 1 incident this run. No smoke from 520, 532 6th Street.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 52

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	DA0E	50.06418	-110.77330
<b>Run End Manhole:</b>	D89E	50.06416	-110.77813

**Comments:** No incidents this run.

**Run:** 53

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D91D	50.06417	-110.77416
<b>Run End Manhole:</b>	6BC77	50.06203	-110.77395

**Comments:** No incidents this run.

**Run:** 54

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	6BC76	50.06241	-110.77271
<b>Run End Manhole:</b>	6BC72	50.06330	-110.77408

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 55

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="6BC6F"/>	50.06329	-110.77554
<b>Run End Manhole:</b>	<input type="text" value="6BC71"/>	50.06261	-110.77407

**Comments:** No incidents this run.

**Run:** 56

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D89E"/>	50.06416	-110.77813
<b>Run End Manhole:</b>	<input type="text" value="D8CC"/>	50.06574	-110.77806

**Comments:** 1 incident this run. No smoke from 813 Mitchell Street.

**Run:** 57

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8D3"/>	50.06514	-110.77886
<b>Run End Manhole:</b>	<input type="text" value="D8A1"/>	50.06316	-110.77894

**Comments:** No incidents this run. No smoke from 832, 836 7th Street.



## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 58

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8A0"/>	50.06420	-110.78182
<b>Run End Manhole:</b>	<input type="text" value="D8A3"/>	50.06417	-110.78038

**Comments:** No incidents this run.

**Run:** 59

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D8E9"/>	50.06606	-110.77889
<b>Run End Manhole:</b>	<input type="text" value="D8D4"/>	50.06870	-110.77890

**Comments:** No incidents this run. No smoke from 724 7th street

**Run:** 60

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D982"/>	50.06973	-110.77884
<b>Run End Manhole:</b>	<input type="text" value="D952"/>	50.07087	-110.77888

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 61

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D921"/>	50.07295	-110.78042
<b>Run End Manhole:</b>	<input type="text" value="D925"/>	50.07605	-110.78034

**Comments:** No incidents this run.

**Run:** 62

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D925"/>	50.07605	-110.78034
<b>Run End Manhole:</b>	<input type="text" value="D997"/>	50.07543	-110.77850

**Comments:** No incidents this run.

**Run:** 63

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D925"/>	50.07605	-110.78034
<b>Run End Manhole:</b>	<input type="text" value="D91F"/>	50.07620	-110.77839

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 64

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D924	50.07503	-110.78038
<b>Run End Manhole:</b>	D993	50.07449	-110.77848

**Comments:** No incidents this run.

**Run:** 65

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D925	50.07605	-110.78034
<b>Run End Manhole:</b>	398BA	50.07708	-110.77812

**Comments:** No incidents this run.

**Run:** 66

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	398BA	50.07708	-110.77812
<b>Run End Manhole:</b>	398B5	50.07709	-110.78038

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 67

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D954	50.07194	-110.79529
<b>Run End Manhole:</b>	D99B	50.07266	-110.79234

**Comments:** No incidents this run.

**Run:** 68

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D95F	50.07522	-110.79085
<b>Run End Manhole:</b>	D959	50.07349	-110.79084

**Comments:** No incidents this run.

**Run:** 69

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D959	50.07349	-110.79084
<b>Run End Manhole:</b>	D955	50.07189	-110.79228

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** South Trunk



**Run:** 70

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D95E	50.08186	-110.79527
<b>Run End Manhole:</b>	D9BD	50.07708	-110.79084

**Comments:** No incidents this run.

**Run:** 71

**Date:** August 19, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9DF	50.08436	-110.78927
<b>Run End Manhole:</b>	D9D2	50.08783	-110.79778

**Comments:** No incidents this run.

**Run:** 72

**Date:** August 19, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9DA	50.08339	-110.79084
<b>Run End Manhole:</b>	D9E6	50.08340	-110.78761

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** Northwest Trunk



**Run:** 73

**Date:** August 19, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9DE	50.08429	-110.79081
<b>Run End Manhole:</b>	D9D1	50.08200	-110.79086

**Comments:** 1 incidents this run.

**Run:** 74

**Date:** August 19, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	3CA9F	50.08188	-110.79231
<b>Run End Manhole:</b>	D9DA	50.08339	-110.79084

**Comments:** 1 incident this run.

**Run:** 75

**Date:** August 19, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	13924	50.08260	-110.79370
<b>Run End Manhole:</b>	D9D3	50.08340	-110.79686

**Comments:** 1 incident this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** Northwest Trunk



**Run:** 76

**Date:** August 19, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D93B	50.07947	-110.79525
<b>Run End Manhole:</b>	D9D4	50.08343	-110.79537

**Comments:** No incidents this run.

**Run:** 77

**Date:** August 19, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9C9	50.08182	-110.79950
<b>Run End Manhole:</b>	D9CE	50.08187	-110.79377

**Comments:** 1 incident this run. (Additional MH #EC5A)

**Run:** 78

**Date:** August 19, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D940	50.08034	-110.79385
<b>Run End Manhole:</b>	13923	50.08221	-110.79385

**Comments:** No incidents this run.

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** Northwest Trunk



**Run:** 79

**Date:** August 19, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D9C5"/>	50.08028	-110.80018
<b>Run End Manhole:</b>	<input type="text" value="D9C4"/>	50.07956	-110.79671

**Comments:** 2 incidents this run. (Additional MH #D9C4)

**Run:** 80

**Date:** August 19, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D9B7"/>	50.07873	-110.08008
<b>Run End Manhole:</b>	<input type="text" value="D9C8"/>	50.08024	-110.79832

**Comments:** 1 incident this run. No smoke from 102 6th Street NW.

**Run:** 81

**Date:** August 20, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D93B"/>	50.07947	-110.79525
<b>Run End Manhole:</b>	<input type="text" value="D9BA"/>	50.07859	-110.79525

**Comments:** 1 incident this run.



## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** Northwest Trunk



**Run:** 82

**Date:** August 20, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D941	50.08027	-110.79375
<b>Run End Manhole:</b>	1420D	50.07878	-110.79381

**Comments:** No incidents this run.

**Run:** 83

**Date:** August 20, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9BB	50.07685	-110.79671
<b>Run End Manhole:</b>	D9C4	50.07956	-110.79671

**Comments:** 1 incident this run.

**Run:** 84

**Date:** August 20, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D9BA	50.07859	-110.79525
<b>Run End Manhole:</b>	D9C2	50.07734	-110.79164

**Comments:** No incidents this run.

---

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** Northwest Trunk



**Run:** 85

**Date:** August 20, 2014

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		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D9AD"/>	50.07402	-110.79814
<b>Run End Manhole:</b>	<input type="text" value="D9B3"/>	50.07655	-110.79966

**Comments:** No incidents this run.

---

**Run:** 86

**Date:** August 20, 2014

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		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D9B4"/>	50.07710	-110.79971
<b>Run End Manhole:</b>	<input type="text" value="D9AE"/>	50.07496	-110.80088

**Comments:** No incidents this run. No smoke from 221 8t Street NW

---

**Run:** 87

**Date:** September 10, 2014

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		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="39FD3"/>	50.07706	-110.79042
<b>Run End Manhole:</b>	<input type="text" value="D9BD"/>	50.07708	-110.79084

**Comments:** No incidents this run.

---

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** Northwest Trunk



**Run:** 88

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="39FD3"/>	50.07706	-110.79042
<b>Run End Manhole:</b>	<input type="text" value="D943"/>	50.07875	-110.78629

**Comments:** No incidents this run.

**Run:** 89

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D9E4"/>	50.08156	-110.78735
<b>Run End Manhole:</b>	<input type="text" value="D890"/>	50.08026	-110.78760

**Comments:** No incidents this run.

**Run:** 90

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D895"/>	50.08099	-110.78626
<b>Run End Manhole:</b>	<input type="text" value="D944"/>	50.07774	-110.78632

**Comments:** No incidents this run. (Additional MH #D946)

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** Northwest Trunk



**Run:** 91

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D896"/>	50.08099	-110.78478
<b>Run End Manhole:</b>	<input type="text" value="D945"/>	50.07745	-110.78507

**Comments:** No incidents this run. (Additional MH #D948)

**Run:** 92

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D94F"/>	50.07768	-110.78333
<b>Run End Manhole:</b>	<input type="text" value="D88B"/>	50.08079	-110.78339

**Comments:** No incidents this run. (Additional MH #D950)

**Run:** 93

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	<input type="text" value="D88A"/>	50.08020	-110.78187
<b>Run End Manhole:</b>	<input type="text" value="D9F0"/>	50.07780	-110.78035

**Comments:** No incidents this run. (Additional MH #D951)

## Runs

**Project:** A14-135 - Redcliff Smoke Test

**Basin:** Northwest Trunk



**Run:** 94

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	E888	50.07905	-110.77771
<b>Run End Manhole:</b>	EA33	50.07830	-110.77969

**Comments:** No incidents this run. (Additional MH #D88A)

**Run:** 95

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	D88A	50.08020	-110.78187
<b>Run End Manhole:</b>	D896	50.08099	-110.78478

**Comments:** No incidents this run.

**Run:** 96

**Date:** September 10, 2014

		<i>Latitude</i>	<i>Longitude</i>
<b>SmokeInduction Manhole:</b>	EC51	50.08126	-110.78769
<b>Run End Manhole:</b>	D9E7	50.08368	-110.78777

**Comments:** No incidents this run.

---

## ***Runs***

***Project:*** A14-135 - Redcliff Smoke Test

***Basin:*** Northwest Trunk



***Run:*** 97

***Date:*** September 10, 2014

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		<i><b>Latitude</b></i>	<i><b>Longitude</b></i>
<i><b>SmokeInduction Manhole:</b></i>	<input type="text" value="D9E4"/>	50.08156	-110.78735
<i><b>Run End Manhole:</b></i>	<input type="text" value="D93E"/>	50.08186	-110.79536

***Comments:*** No incidents this run.

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## **Appendix 2**

### **Smoke Test Incident Reports**

(Revised 21NOV14)

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 4

**Incident:** 1

**Incident Location:** 14 Redcliff Way SW.

**Lat:** 50.06248 **Long:** -110.79049

**Upstream Manhole:** D9A8

**Lat:** 50.06259 **Long:** 110.79122

**Downstream Manhole:** D9A9

**Lat:** 50.06260 **Long:** 110.79243

**Result:** Positive

**Leak Source:** Downspout Conne

**Leak Type:** RWL

**Leak Size:** Major

**Leak Surface Cover:** CD

**Observations:** Downspout from eaves connected to sanitary service.

**Comments:**



1a - 26AUG14

**Basin:** South Trunk

**Run:** 4

**Incident:** 1

**Incident Location:** 14 Redcliff Way SW.

**Lat:** 50.06248 **Long:** -110.79049

**Upstream Manhole:** D9A8

**Lat:** 50.06259 **Long:** 110.79122

**Downstream Manhole:** D9A9

**Lat:** 50.06260 **Long:** 110.79243

**Result:** Positive

**Leak Source:** Downspout Conne

**Leak Type:** RWL

**Leak Size:** Major

**Leak Surface Cover:** CD

**Observations:** Downspout from eaves connected to sanitary service.

**Comments:**



1 - 26AUG14



## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 13

**Incident:** 2

**Incident Location:** 421 5th Avenue SW.

**Lat:** 50.07017 **Long:** -110.79644

**Upstream Manhole:** DA00

**Lat:** 50.07046 **Long:** 110.79522

**Downstream Manhole:** D9FF

**Lat:** 50.07026 **Long:** 110.79684

**Result:** Positive

**Leak Source:** Cleanout

**Leak Type:** CCD

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Cleanout Cap Defective. Next to concrete steps of residence.

**Comments:**



2 - 26AUG14

**Basin:** South Trunk

**Run:** 13

**Incident:** 2

**Incident Location:** 421 5th Avenue SW.

**Lat:** 50.07017 **Long:** -110.79644

**Upstream Manhole:** DA00

**Lat:** 50.07046 **Long:** 110.79522

**Downstream Manhole:** D9FF

**Lat:** 50.07026 **Long:** 110.79684

**Result:** Positive

**Leak Source:** Cleanout

**Leak Type:** CCD

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Cleanout Cap Defective. Next to concrete steps of residence.

**Comments:**



2a - 26AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 17

**Incident:** 3

**Incident Location:** 7 Riverview Drive SE.

**Lat:** 50.06185 **Long:** -110.78314

**Upstream Manhole:** D8B1

**Lat:** 50.06180 **Long:** 110.78325

**Downstream Manhole:** D8B3

**Lat:** 50.06262 **Long:** 110.78331

**Result:** Positive

**Leak Source:** Downspout Conne

**Leak Type:** RWL

**Leak Size:** Major

**Leak Surface Cover:** CD/T

**Observations:** Downspout from eaves connected to sanitary service.

**Comments:**



3 - 26AUG14

**Basin:** South Trunk

**Run:** 17

**Incident:** 3

**Incident Location:** 7 Riverview Drive SE.

**Lat:** 50.06185 **Long:** -110.78314

**Upstream Manhole:** D8B1

**Lat:** 50.06180 **Long:** 110.78325

**Downstream Manhole:** D8B3

**Lat:** 50.06262 **Long:** 110.78331

**Result:** Positive

**Leak Source:** Downspout Conne

**Leak Type:** RWL

**Leak Size:** Major

**Leak Surface Cover:** CD/T

**Observations:** Downspout from eaves connected to sanitary service.

**Comments:**



3a - 26AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 23

**Incident:** 4

**Incident Location:** 229 1st Street SE.

**Lat:** 50.07402 **Long:** -110.78769

**Upstream Manhole:** D977

**Lat:** 50.07494 **Long:** 110.78776

**Downstream Manhole:** D968

**Lat:** 50.07296 **Long:** 110.78779

**Result:** Suspect

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Medium

**Leak Surface Cover:** A

**Observations:** Smoke from cracked collar Manhole #D978.

**Comments:**



4 - 27AUG14

**Basin:** South Trunk

**Run:** 23

**Incident:** 4

**Incident Location:** 229 1st Street SE.

**Lat:** 50.07402 **Long:** -110.78769

**Upstream Manhole:** D977

**Lat:** 50.07494 **Long:** 110.78776

**Downstream Manhole:** D968

**Lat:** 50.07296 **Long:** 110.78779

**Result:** Suspect

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Medium

**Leak Surface Cover:** A

**Observations:** Smoke from cracked collar Manhole #D978.

**Comments:**



4a - 27AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 24

**Incident:** 5

**Incident Location:** 515 1st Street SE.

**Lat:** 50.06985 **Long:** -110.78774

**Upstream Manhole:** D97A

**Lat:** 50.07087 **Long:** 110.78785

**Downstream Manhole:** D8DA

**Lat:** 50.06886 **Long:** 110.78771

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D979

**Comments:**



5 - 27AUG14

**Basin:** South Trunk

**Run:** 24

**Incident:** 5

**Incident Location:** 515 1st Street SE.

**Lat:** 50.06985 **Long:** -110.78774

**Upstream Manhole:** D97A

**Lat:** 50.07087 **Long:** 110.78785

**Downstream Manhole:** D8DA

**Lat:** 50.06886 **Long:** 110.78771

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D979

**Comments:**



5a - 27AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 34

**Incident:** 6

**Incident Location:** 312 3rd Street SE.

**Lat:** 50.07282 **Long:** -110.78485

**Upstream Manhole:** 15611

**Lat:** 50.07083 **Long:** 110.78478

**Downstream Manhole:** D931

**Lat:** 50.07475 **Long:** 110.78483

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D92F

**Comments:**



6a - 28AUG14

**Basin:** South Trunk

**Run:** 34

**Incident:** 6

**Incident Location:** 312 3rd Street SE.

**Lat:** 50.07282 **Long:** -110.78485

**Upstream Manhole:** 15611

**Lat:** 50.07083 **Long:** 110.78478

**Downstream Manhole:** D931

**Lat:** 50.07475 **Long:** 110.78483

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D92F

**Comments:**



6 - 28AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 34

**Incident:** 7

**Incident Location:** 233 3rd Street SE.

**Lat:** 50.07384 **Long:** -110.78479

**Upstream Manhole:** D931

**Lat:** 50.07475 **Long:** 110.78483

**Downstream Manhole:** D92E

**Lat:** 50.07190 **Long:** 110.78481

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D930

**Comments:**



7 - 28AUG14

**Basin:** South Trunk

**Run:** 34

**Incident:** 7

**Incident Location:** 233 3rd Street SE.

**Lat:** 50.07384 **Long:** -110.78479

**Upstream Manhole:** D931

**Lat:** 50.07475 **Long:** 110.78483

**Downstream Manhole:** D92E

**Lat:** 50.07190 **Long:** 110.78481

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D930

**Comments:**



7a - 28AUG14



## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 34

**Incident:** 8

**Incident Location:** 427 3rd Street SE.

**Lat:** 50.07083 **Long:** -110.78478

**Upstream Manhole:** D92E

**Lat:** 50.07190 **Long:** 110.78481

**Downstream Manhole:** D976

**Lat:** 50.06983 **Long:** 110.78479

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #15611

**Comments:**



8 - 28AUG14

**Basin:** South Trunk

**Run:** 34

**Incident:** 8

**Incident Location:** 427 3rd Street SE.

**Lat:** 50.07083 **Long:** -110.78478

**Upstream Manhole:** D92E

**Lat:** 50.07190 **Long:** 110.78481

**Downstream Manhole:** D976

**Lat:** 50.06983 **Long:** 110.78479

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #15611

**Comments:**



8a - 28AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 34

**Incident:** 9

**Incident Location:** 237 3rd Street SE

**Lat:** 50.07368 **Long:** -110.78441

**Upstream Manhole:** D931

**Lat:** 50.07475 **Long:** 110.78483

**Downstream Manhole:** D930

**Lat:** 50.07384 **Long:** 110.78479

**Result:** Positive

**Leak Source:** Abandoned Servic

**Leak Type:** SC

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Abandoned service. Inflow from yard.

**Comments:**



9 - 28AUG14

**Basin:** South Trunk

**Run:** 34

**Incident:** 9

**Incident Location:** 237 3rd Street SE

**Lat:** 50.07368 **Long:** -110.78441

**Upstream Manhole:** D931

**Lat:** 50.07475 **Long:** 110.78483

**Downstream Manhole:** D930

**Lat:** 50.07384 **Long:** 110.78479

**Result:** Positive

**Leak Source:** Abandoned Servic

**Leak Type:** SC

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Abandoned service. Inflow from yard.

**Comments:**



9a - 28AUG14



## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 35

**Incident:** 10

**Incident Location:** 515 3rd Street SE.

**Lat:** 50.06983 **Long:** -110.78479

**Upstream Manhole:** 15611

**Lat:** 50.07083 **Long:** 110.78478

**Downstream Manhole:** D8D8

**Lat:** 50.06875 **Long:** 110.78482

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D976

**Comments:**



10a - 28AUG14

**Basin:** South Trunk

**Run:** 35

**Incident:** 10

**Incident Location:** 515 3rd Street SE.

**Lat:** 50.06983 **Long:** -110.78479

**Upstream Manhole:** 15611

**Lat:** 50.07083 **Long:** 110.78478

**Downstream Manhole:** D8D8

**Lat:** 50.06875 **Long:** 110.78482

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D976

**Comments:**



10 - 28AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 51

**Incident:** 11

**Incident Location:** 515 6th Street SE

**Lat:** 50.06975 **Long:** -110.78035

**Upstream Manhole:** D980

**Lat:** 50.07196 **Long:** 110.78037

**Downstream Manhole:** D8D5

**Lat:** 50.06875 **Long:** 110.78036

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D981

**Comments:**



11a - 29AUG14

**Basin:** South Trunk

**Run:** 51

**Incident:** 11

**Incident Location:** 515 6th Street SE

**Lat:** 50.06975 **Long:** -110.78035

**Upstream Manhole:** D980

**Lat:** 50.07196 **Long:** 110.78037

**Downstream Manhole:** D8D5

**Lat:** 50.06875 **Long:** 110.78036

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D981

**Comments:**



11 - 29AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** South Trunk

**Run:** 56

**Incident:** 12

**Incident Location:** 8th Avenue SE & Mitchell Street SE

**Lat:** 50.06574 **Long:** -110.77806

**Upstream Manhole:** D8CC

**Lat:** 50.06574 **Long:** 110.77806

**Downstream Manhole:** D8CD

**Lat:** 50.06498 **Long:** 110.77806

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D8CC

**Comments:**



12 - 10SEP14

**Basin:** South Trunk

**Run:** 56

**Incident:** 12

**Incident Location:** 8th Avenue SE & Mitchell Street SE

**Lat:** 50.06574 **Long:** -110.77806

**Upstream Manhole:** D8CC

**Lat:** 50.06574 **Long:** 110.77806

**Downstream Manhole:** D8CD

**Lat:** 50.06498 **Long:** 110.77806

**Result:** Positive

**Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around collar of Manhole #D8CC

**Comments:**



12a - 10SEP14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** Northwest Trunk **Run:** 73

**Incident:** 13

**Incident Location:** 418 1st Street NW

**Lat:** 50.08411 **Long:** -110.790618

**Upstream Manhole:** D9DE **Lat:** 50.08429 **Long:** 110.79081

**Downstream Manhole:** D9DB **Lat:** 50.08390 **Long:** 110.79085

**Result:** Positive **Leak Source:** Downspout Conne

**Leak Type:** RWL

**Leak Size:** Major

**Leak Surface Cover:** CD

**Observations:** Downspout from eaves connected to sanitary service.

**Comments:**



13 - 19AUG14

**Basin:** Northwest Trunk **Run:** 73

**Incident:** 13

**Incident Location:** 418 1st Street NW

**Lat:** 50.08411 **Long:** -110.790618

**Upstream Manhole:** D9DE **Lat:** 50.08429 **Long:** 110.79081

**Downstream Manhole:** D9DB **Lat:** 50.08390 **Long:** 110.79085

**Result:** Positive **Leak Source:** Downspout Conne

**Leak Type:** RWL

**Leak Size:** Major

**Leak Surface Cover:** CD

**Observations:** Downspout from eaves connected to sanitary service.

**Comments:**



13a - 19AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** Northwest Trunk **Run:** 74

**Incident:** 14

**Incident Location:** 314 2nd Street NW.

**Lat:** 50.082373 **Long:** -110.792195

**Upstream Manhole:** D9D7 **Lat:** 50.08344 **Long:** 110.79225

**Downstream Manhole:** D9D0 **Lat:** 50.08229 **Long:** 110.79234

**Result:** Positive **Leak Source:** Cleanout

**Leak Type:** CCD

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Cleanout Cap Defective

**Comments:**



14 - 19AUG14

**Basin:** Northwest Trunk **Run:** 74

**Incident:** 14

**Incident Location:** 314 2nd Street NW.

**Lat:** 50.082373 **Long:** -110.792195

**Upstream Manhole:** D9D7 **Lat:** 50.08344 **Long:** 110.79225

**Downstream Manhole:** D9D0 **Lat:** 50.08229 **Long:** 110.79234

**Result:** Positive **Leak Source:** Cleanout

**Leak Type:** CCD

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Cleanout Cap Defective

**Comments:**



14a - 19AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** Northwest Trunk **Run:** 75

**Incident:** 15

**Incident Location:** 301 4th Avenue NW

**Lat:** 50.08343 **Long:** -110.79537

**Upstream Manhole:** D9D3 **Lat:** 50.08340 **Long:** 110.79686

**Downstream Manhole:** D9D4 **Lat:** 50.08343 **Long:** 110.79537

**Result:** Positive **Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from offset MH Collar at MH #D9D4

**Comments:**



15a - 19AUG14

**Basin:** Northwest Trunk **Run:** 75

**Incident:** 15

**Incident Location:** 301 4th Avenue NW

**Lat:** 50.08343 **Long:** -110.79537

**Upstream Manhole:** D9D3 **Lat:** 50.08340 **Long:** 110.79686

**Downstream Manhole:** D9D4 **Lat:** 50.08343 **Long:** 110.79537

**Result:** Positive **Leak Source:** Manhole Collar

**Leak Type:** MHC

**Leak Size:** Small

**Leak Surface Cover:** A

**Observations:** Smoke from offset MH Collar at MH #D9D4

**Comments:**



15 - 19AUG14



## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** Northwest Trunk **Run:** 77

**Incident:** 16

**Incident Location:** 122 5th Street NW.

**Lat:** 50.08007 **Long:** -110.79646

**Upstream Manhole:** D9C4 **Lat:** 50.07956 **Long:** 110.79671

**Downstream Manhole:** D9CB **Lat:** 50.08029 **Long:** 110.79680

**Result:** Positive **Leak Source:** Abandoned Servic

**Leak Type:** SC

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Smoke from abandoned service. Inflow from yard.

**Comments:**



16 - 19AUG14

**Basin:** Northwest Trunk **Run:** 77

**Incident:** 16

**Incident Location:** 122 5th Street NW.

**Lat:** 50.08007 **Long:** -110.79646

**Upstream Manhole:** D9C4 **Lat:** 50.07956 **Long:** 110.79671

**Downstream Manhole:** D9CB **Lat:** 50.08029 **Long:** 110.79680

**Result:** Positive **Leak Source:** Abandoned Servic

**Leak Type:** SC

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Smoke from abandoned service. Inflow from yard.

**Comments:**



16a - 19AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** Northwest Trunk **Run:** 79

**Incident:** 17

**Incident Location:** 122 5th Street NW

**Lat:** 50.08009 **Long:** -110.79626

**Upstream Manhole:** D9C4 **Lat:** 50.07956 **Long:** 110.79671

**Downstream Manhole:** D9CB **Lat:** 50.08029 **Long:** 110.79680

**Result:** Positive **Leak Source:** Abandoned Servic

**Leak Type:** SC

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Smoke from abandoned service. Inflow from yard.

**Comments:**



17 - 19AUG14

**Basin:** Northwest Trunk **Run:** 79

**Incident:** 17

**Incident Location:** 122 5th Street NW

**Lat:** 50.08009 **Long:** -110.79626

**Upstream Manhole:** D9C4 **Lat:** 50.07956 **Long:** 110.79671

**Downstream Manhole:** D9CB **Lat:** 50.08029 **Long:** 110.79680

**Result:** Positive **Leak Source:** Abandoned Servic

**Leak Type:** SC

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Smoke from abandoned service. Inflow from yard.

**Comments:**



17a - 19AUG14



## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** Northwest Trunk **Run:** 80

**Incident:** 18

**Incident Location:** Intersection at 7th Street NW & 1st Avenue NW

**Lat:** 50.07873 **Long:** -110.79977

**Upstream Manhole:** D9B7 **Lat:** 50.07873 **Long:** 110.08008

**Downstream Manhole:** D9B9 **Lat:** 50.07870 **Long:** 110.79802

**Result:** Positive **Leak Source:** Cracked Concrete

**Leak Type:** MHC

**Leak Size:** Medium

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around MH #D9B8. Inflow from street.

**Comments:**



18 - 19AUG14

**Basin:** Northwest Trunk **Run:** 80

**Incident:** 18

**Incident Location:** Intersection at 7th Street NW & 1st Avenue NW

**Lat:** 50.07873 **Long:** -110.79977

**Upstream Manhole:** D9B7 **Lat:** 50.07873 **Long:** 110.08008

**Downstream Manhole:** D9B9 **Lat:** 50.07870 **Long:** 110.79802

**Result:** Positive **Leak Source:** Cracked Concrete

**Leak Type:** MHC

**Leak Size:** Medium

**Leak Surface Cover:** A

**Observations:** Smoke from asphalt around MH #D9B8. Inflow from street.

**Comments:**



18a - 19AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** Northwest Trunk **Run:** 81

**Incident:** 19

**Incident Location:** 115 4th Street NW.

**Lat:** 50.07930 **Long:** -110.79525

**Upstream Manhole:** DD0C **Lat:** 50.07866 **Long:** 110.79511

**Downstream Manhole:** D93B **Lat:** 50.07947 **Long:** 110.79525

**Result:** Positive **Leak Source:** Smoking Ground

**Leak Type:** SC

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Smoke from ground. Potential broken service lateral.

**Comments:**



19 - 20AUG14

**Basin:** Northwest Trunk **Run:** 81

**Incident:** 19

**Incident Location:** 115 4th Street NW.

**Lat:** 50.07930 **Long:** -110.79525

**Upstream Manhole:** DD0C **Lat:** 50.07866 **Long:** 110.79511

**Downstream Manhole:** D93B **Lat:** 50.07947 **Long:** 110.79525

**Result:** Positive **Leak Source:** Smoking Ground

**Leak Type:** SC

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Smoke from ground. Potential broken service lateral.

**Comments:**



19a - 20AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** Northwest Trunk **Run:** 83

**Incident:** 20

**Incident Location:** 8 5th Street SW

**Lat:** 50.07665 **Long:** -110.79701

**Upstream Manhole:** D9BB **Lat:** 50.07685 **Long:** 110.79671

**Downstream Manhole:** D9BE **Lat:** 50.07718 **Long:** 110.79681

**Result:** Positive **Leak Source:** Abandoned Servic

**Leak Type:** sc

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Smoke from abandoned service. Yard inflow.

**Comments:**



20 - 20AUG14

**Basin:** Northwest Trunk **Run:** 83

**Incident:** 20

**Incident Location:** 8 5th Street SW

**Lat:** 50.07665 **Long:** -110.79701

**Upstream Manhole:** D9BB **Lat:** 50.07685 **Long:** 110.79671

**Downstream Manhole:** D9BE **Lat:** 50.07718 **Long:** 110.79681

**Result:** Positive **Leak Source:** Abandoned Servic

**Leak Type:** sc

**Leak Size:** Medium

**Leak Surface Cover:** T

**Observations:** Smoke from abandoned service. Yard inflow.

**Comments:**



20a - 20AUG14

## A14-135 - Redcliff Smoke Test

### Smoke Test Incidents



**Basin:** Northwest Trunk **Run:** 86

**Incident:** 21

**Incident Location:** 601 Broadway Avenue W

**Lat:** 50.07678 **Long:** -110.79909

**Upstream Manhole:** D9B4 **Lat:** 50.07710 **Long:** 110.79971

**Downstream Manhole:** D9B5 **Lat:** 50.07734 **Long:** 110.79839

**Result:** Positive **Leak Source:** Cleanout

**Leak Type:** CCD

**Leak Size:** Small

**Leak Surface Cover:** T

**Observations:** Smoke from steel drum next to address. Cleanout cap defective.

**Comments:**



21a - 20AUG14

**Basin:** Northwest Trunk **Run:** 86

**Incident:** 21

**Incident Location:** 601 Broadway Avenue W

**Lat:** 50.07678 **Long:** -110.79909

**Upstream Manhole:** D9B4 **Lat:** 50.07710 **Long:** 110.79971

**Downstream Manhole:** D9B5 **Lat:** 50.07734 **Long:** 110.79839

**Result:** Positive **Leak Source:** Cleanout

**Leak Type:** CCD

**Leak Size:** Small

**Leak Surface Cover:** T

**Observations:** Smoke from steel drum next to address. Cleanout cap defective.

**Comments:**



21 - 20AUG14



## **Appendix C**

### CCTV Investigation Results







Final Report for  
**ISL Engineering Ltd.**

Attn: Mr. Geoffrey Schulmeister, P.Eng.

**Town of Redcliff, Alberta**  
CCTV Sewer Inspection 2014

---



**Prepared and submitted by:**

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October 31, 2014

**ISL Engineering and Land Service Ltd.**

#1, 6325 – 12<sup>th</sup> Street SE.  
Calgary, AB. T2H 2K1

Attn: Mr. Geoffrey Schulmeister, P.Eng.

---

FINAL REPORT: 2014 CCTV SEWER INSPECTION  
Redcliff, Alberta

---

Dear Mr. Schulmeister;

Please find enclosed SFE's Final Report for the above mentioned project. If you have any questions, comments or concerns, please do not hesitate to contact us at your earliest convenience.

Thank you for having SFE conduct this work on your behalf. We are appreciative of the opportunity to work with you and your team on this project. We look forward to working together again in the near future.

Sincerely,  
SFE Global

Kevin McMillan  
Vice-President  
(780) 461-0171 x 202  
kevin.mcmillan@sfeGLOBAL.com  
[www.sfeGLOBAL.com](http://www.sfeGLOBAL.com)



## TABLE OF CONTENTS

### Section 1

Executive Summary.....	4
------------------------	---

### Section 2

CCTV Procedures.....	4
----------------------	---

### Section 3

Safety .....	5
--------------	---

### Section 4

Conclusion.....	5
-----------------	---

### Appendices

Appendix I – CCTV Inspection Reports

Appendix II – Project Maps

Appendix III – Project Photos

## 1. Executive Summary

This report provides details of the CCTV Sewer Inspection conducted in Redcliff, Alberta. SFE Global was retained by ISL Engineering under the direction of Mr. Geoffrey Schulmeister, P. Eng. Mr. Kevin McMillan represented SFE Global as Project Manager during this project.

As requested, SFE conducted CCTV inspections of the sanitary sewer system between September 9<sup>th</sup> and 12<sup>th</sup>, 2014. The assessment was requested in order to provide condition assessment information on existing infrastructure within the Town. All inspection requests and test requirements were indicated to SFE during pre-project planning meetings, and were outlined on maps supplied by the client.

## 2. CCTV Procedures

SFE utilizes state of the art video inspection equipment enclosed in our custom designed mobile workspace. A color pan, tilt and zoom camera is transported by a selection of wheeled and track propelled crawlers.

Video data is captured digitally and encoded with custom industry standard software. Final reporting is saved on DVD and included with this report. Inspection summaries with photos of significant observations are included in Appendix I.



Sewer sections are named according to drawings and numbering conventions supplied by the client. Sewer sections are always named from the upstream manhole downstream to the next manhole identified. Inspections are numbered according to project, and sequenced from inspection number one, onward.

Crawler direction is generally downstream but is identified in the video and reports with the ">" symbol. For example, MH1 downstream to MH2, would be identified as MH1 > MH2. MH2 upstream to MH1 would be identified as MH2 < MH1.

Defects are coded according to the SRC system to show lateral connections, pipe deformation and cracking, service conditions such as debris, and sags. Water level is recorded at the start of each survey and generally when changes greater than 10% are observed. This allows quantification of the severity of sags and blockages.

Technicians performed testing according to the above protocol. Tests were performed to SFE Standard Procedures.

## 3. Safety

A pre-job safety inspection and meeting was conducted by SFE personnel, and the following potential hazards were identified:

- Need for Personal Protective Equipment
- Safe Confined Space Entry Procedures
- Pedestrian and vehicular traffic conditions
- Safe operation of CCTV equipment

This project was conducted in accordance with the WCB and OSHA safety standards as documented in SFE's Safety Procedures Manual. The SFE crew reviewed the work to be completed and safety requirements at a tail-gate safety meeting held prior to commencing work.

## 4. Conclusion

Overall, CCTV work completed showed a mix of acceptable system condition and deteriorating infrastructure. This was expected and dependent on the age of the associated construction. No unexpected connections were encountered but many lateral connections at greenhouses showed considerable base flow. Without knowing the process at these facilities this may or may not be expected.

One overriding observation and challenge to the CCTV work and proper operation of the system was the significant level of gravel and debris in the system. The pipe section D95C Northbound could not be done due to debris and limited access in the North manhole, and excavation and construction at D95C. A thorough flushing / vacuuming program in the sanitary sewer system would significantly improve performance by reducing head loss, in our opinion.

Further to the CCTV work SFE technicians performed discharge pressure testing on the 3<sup>rd</sup> Avenue NW lift station. Debris in the discharge force main could be causing reduced flow rates and accompanying station lack of capacity. Results were:

Pump 1 - Status / Pressure	Pump 2 – Status / Pressure (psi)
On / 22	OFF
On / 27	On / 27
OFF	On / 26

Report End  
October 2014

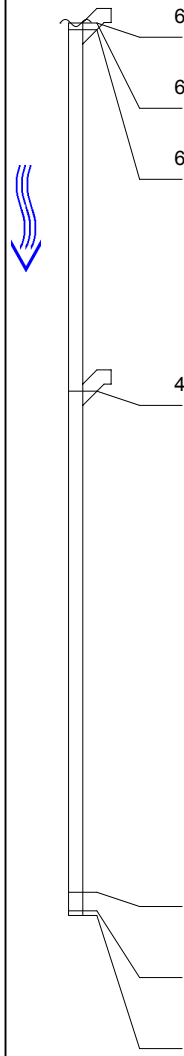







SFE Global  
Project A14-135

## Appendix I Inspections

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-01	<b>Address:</b> 511 3rd Ave NW	<b>Sewer:</b> D9C9	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D9CA	<b>Total length:</b> 69.84 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D9C9	<b>Page:</b> 1
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

	Start	End	Code		Description	DC Video	Photo
	69.84	69.84	FH		End of Survey	00:00:00	
	69.84	69.84	BM		Debris Moderate - < 25% flow area restriction from 5 to 7 o'clock. No evidence of flow from upstream of debris.	00:00:00	3
	69.32	69.32	CN		Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle. Clear water inflow light.	00:00:00	2
	41.34	41.34	CN		Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle. Clear water inflow moderate	00:00:00	1
	2.55	2.55	II		WL-5%. Clear Water	00:00:00	
	1.11	1.11	II		WL-0%	00:00:00	
	0.75	0.75	ST		Start of Survey , 200 mm, PVC, Circle	00:00:00	

# easyCAN

Licence: #024137

SFE Global Ltd.  
10743 178th Street  
Edmonton, Alberta T5S-1J6  
Phone # 1-877-293-0173  
Fax # 780-443-4613



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-01	<b>Address:</b> 511 3rd Ave NW	<b>Sewer:</b> D9C9	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D9CA	<b>Total length:</b> 69.84 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D9C9	<b>Page:</b> 2
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

## sewer inspection



Photo : 1

Distance : 41.34 m

Video : 00:00:00

DC :

Code : CN

Service Connection from  
1 to 3 o'clock, 100 mm,  
PVC, Circle. Clear water  
inflow moderate



Photo : 2

Distance : 69.32 m

Video : 00:00:00

DC :

Code : CN

Service Connection from  
1 to 3 o'clock, 100 mm,  
PVC, Circle. Clear water  
inflow light.



# easyCAN

Licence: #024137

SFE Global Ltd.  
10743 178th Street  
Edmonton, Alberta T5S-1J6  
Phone # 1-877-293-0173  
Fax # 780-443-4613



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-01	<b>Address:</b> 511 3rd Ave NW	<b>Sewer:</b> D9C9	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D9CA	<b>Total length:</b> 69.84 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D9C9	<b>Page:</b> 3
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

## sewer inspection



**Photo** : 3

**Distance** : 69.84 m

**Video** : 00:00:00

**DC** :

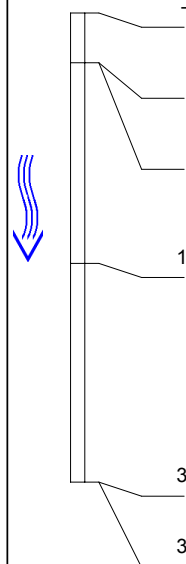
**Code** : BM

Debris Moderate - < 25%  
flow area restriction from 5  
to 7 o'clock. No evidence  
of flow from upstream of  
debris.

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-02	<b>Address:</b> 511 3rd Ave NW	<b>Sewer:</b> D9CA	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D9CA	<b>Total length:</b> 4.89 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D9CC	<b>Page:</b> 4
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	-3.11	-3.11	II	Moderate volume of dark water discharge from upstream.	00:00:00	2
	0.75	0.75	ST	Start of Survey , 200 mm, PVC, Circle	00:00:00	
	0.75	0.75	II	WL-5%	00:00:00	
	16.27	16.27	BL	Debris Light - Sewer flow not affected	00:00:00	
	33.20	33.20	BM	Debris Moderate - < 25% flow area restriction from 5 to 7 o'clock	00:00:00	3
	33.20	33.20	FH	End of Survey . Unable to pass debris.	00:00:00	



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-02	<b>Address:</b> 511 3rd Ave NW	<b>Sewer:</b> D9CA	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D9CA	<b>Total length:</b> 4.89 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D9CC	<b>Page:</b> 5
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

## sewer inspection

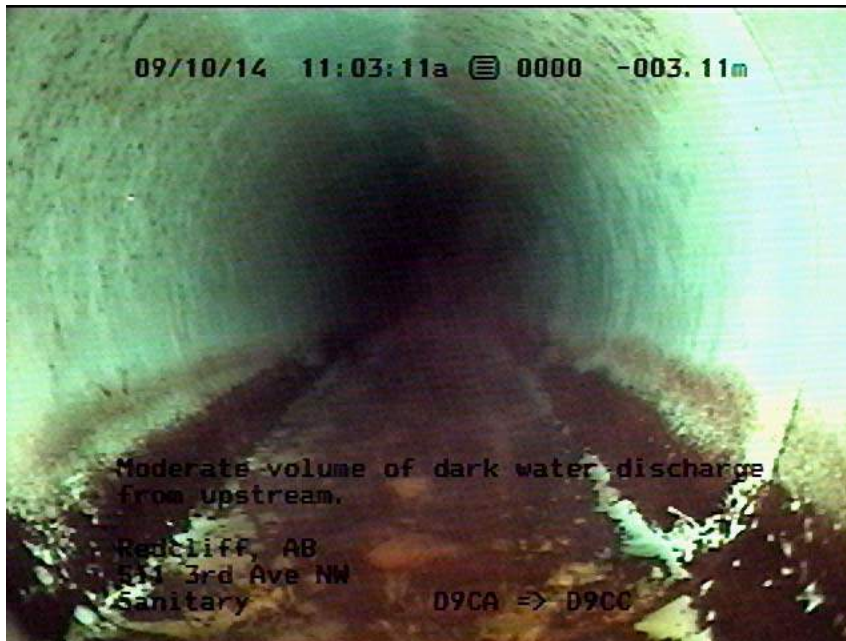


Photo : 2

Distance : -3.11 m

Video : 00:00:00

DC :

Code : II

Moderate volume of dark water discharge from upstream.



Photo : 3

Distance : 33.20 m

Video : 00:00:00

DC :

Code : BM

Debris Moderate - < 25% flow area restriction from 5 to 7 o'clock

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-03	<b>Address:</b> 413 Stone PI SW	<b>Sewer:</b> D95D	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D95D	<b>Total length:</b> 82.78 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D966	<b>Page:</b> 6
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

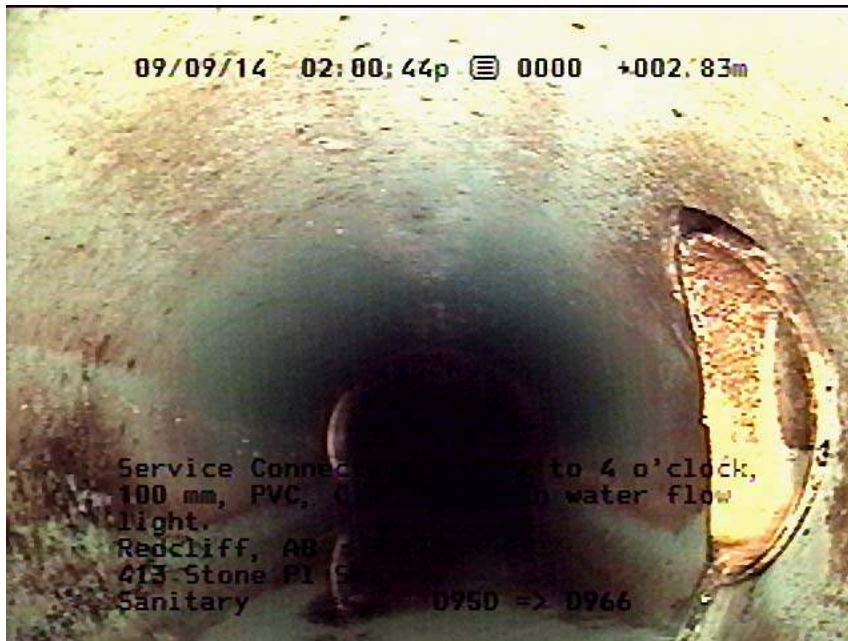
1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	0.75	0.75	ST	Start of Survey , 200 mm, PVC, Circle	00:00:00	
	0.75	0.75	II	WL-5%	00:00:00	
	2.83	2.83	CN	Service Connection from 2 to 4 o'clock, 100 mm, PVC, Circle. Clean water flow light.	00:00:00	1
	3.60	3.60	CN	Service Connection from 8 to 10 o'clock, 100 mm, PVC, Circle	00:00:00	
	17.55	17.55	CN	Service Connection from 8 to 10 o'clock, 100 mm, PVC, Circle. Clean water flow light.	00:00:00	2
	18.05	18.05	CN	Service Connection from 2 to 4 o'clock, 100 mm, PVC, Circle	00:00:00	
	33.57	33.57	CN	Service Connection from 8 to 10 o'clock, 100 mm, PVC, Circle	00:00:00	
	34.26	34.26	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	50.37	50.37	CN	Service Connection from 8 to 10 o'clock, 100 mm, PVC, Circle. Clean water flow light.	00:00:00	3
	51.05	51.05	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	66.56	66.56	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	67.70	67.70	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	67.70	67.70	EM	Encrustation Moderate - < 25% flow area restriction from 9 to 11 o'clock	00:00:00	4
	79.14	79.14	LD	Line Deviation Down	00:00:00	
	82.78	82.78	FH	End of Survey . Unable to pass.	00:00:00	
	84.21	84.21	II	WL-50%	00:00:00	
	84.21	84.21	SS	Sag Severe	00:00:00	7
	84.33	84.33	FH	End of Survey . Camera underwater.	00:00:00	

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-03	<b>Address:</b> 413 Stone Pl SW	<b>Sewer:</b> D95D	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D95D	<b>Total length:</b> 82.78 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D966	<b>Page:</b> 7
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

## sewer inspection



**Photo** : 1  
**Distance** : 2.83 m  
**Video** : 00:00:00  
**DC** :  
**Code** : CN  
Service Connection from  
2 to 4 o'clock, 100 mm,  
PVC, Circle. Clean water  
flow light.



**Photo** : 2  
**Distance** : 17.55 m  
**Video** : 00:00:00  
**DC** :  
**Code** : CN  
Service Connection from  
8 to 10 o'clock, 100 mm,  
PVC, Circle. Clean water  
flow light.



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-03	<b>Address:</b> 413 Stone Pl SW	<b>Sewer:</b> D95D	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D95D	<b>Total length:</b> 82.78 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D966	<b>Page:</b> 8
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

## sewer inspection



Photo : 3

Distance : 50.37 m

Video : 00:00:00

DC :

Code : CN

Service Connection from  
8 to 10 o'clock, 100 mm,  
PVC, Circle. Clean water  
flow light.



Photo : 4

Distance : 67.70 m

Video : 00:00:00

DC :

Code : EM

Encrustation Moderate -  
< 25% flow area restriction  
from 9 to 11 o'clock

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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-03	<b>Address:</b> 413 Stone Pl SW	<b>Sewer:</b> D95D	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D95D	<b>Total length:</b> 82.78 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D966	<b>Page:</b> 9
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

## sewer inspection



Photo : 7  
Distance : 84.21 m  
Video : 00:00:00  
DC :  
Code : SS  
Sag Severe

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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-03R	<b>Address:</b> 413 Stone PI SW	<b>Sewer:</b> D95D	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D966	<b>Total length:</b> 82.78 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D95D	<b>Page:</b> 10
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

1 : 550











## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	0.75	0.75	ST	Start of Survey , 200 mm, PVC, Circle	00:00:00	
	-0.72	-0.72	FH	End of Survey . Camera Underwater	00:00:00	
	-0.72	-0.72	LH	Lamphole	00:00:00	
	-1.61	-1.61	II	WL-40%	00:00:00	

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-04	<b>Address:</b> 8th Ave and 5th St SE	<b>Sewer:</b> D8CA	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D1	<b>Total length:</b> 29.79 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8CA	<b>Page:</b> 11
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

	Start	End	Code		Description	DC Video	Photo
	29.79	29.79	II		Note survey is D8D1 downstream to D8A0	00:00:00	3
	29.79	29.79	FH		End of Survey	00:00:00	
	29.79	29.79	II		Protrusion unable to pass.	00:00:00	
	29.22	29.22	CN		Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	21.52	21.52	CN		Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	14.66	14.66	CN		Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	2
	6.55	6.55	EM		Encrustation Moderate - < 25% flow area restriction from 1 to 2 o'clock	00:00:00	1
	6.55	6.55	CN		Service Connection from 1 to 2 o'clock, 100 mm, PVC, Circle	00:00:00	
	0.75	0.75	II		WL-5%	00:00:00	
	0.75	0.75	ST		Start of Survey , 200 mm, ACP Asbestos Cement Pipe, Circle	00:00:00	



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-04	<b>Address:</b> 8th Ave and 5th St SE	<b>Sewer:</b> D8CA	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D1	<b>Total length:</b> 29.79 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8CA	<b>Page:</b> 12
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Not cleaned

## sewer inspection



Photo : 1  
Distance : 6.55 m  
Video : 00:00:00  
DC :  
Code : EM  
Encrustation Moderate -  
< 25% flow area restriction  
from 1 to 2 o'clock

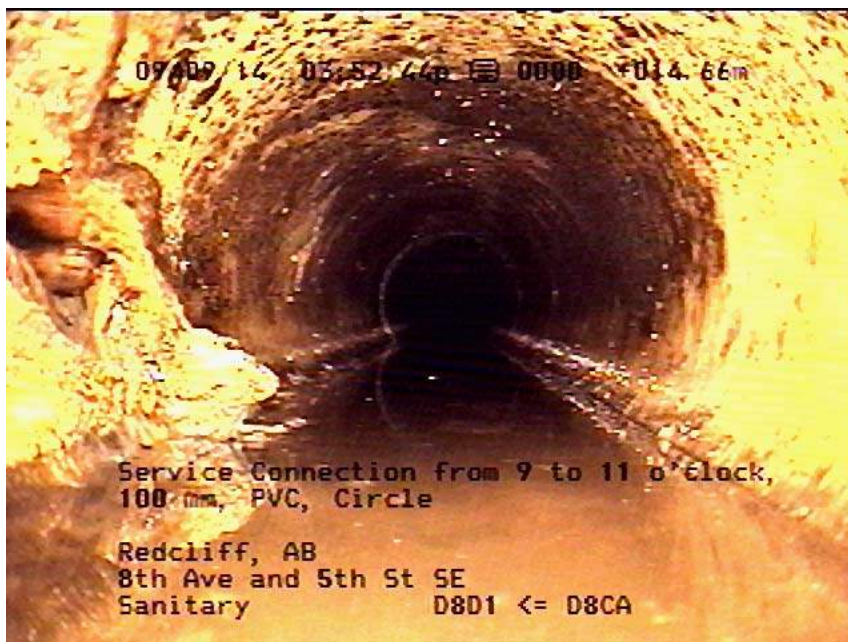


Photo : 2  
Distance : 14.66 m  
Video : 00:00:00  
DC :  
Code : CN  
Service Connection from  
9 to 11 o'clock, 100 mm,  
PVC, Circle



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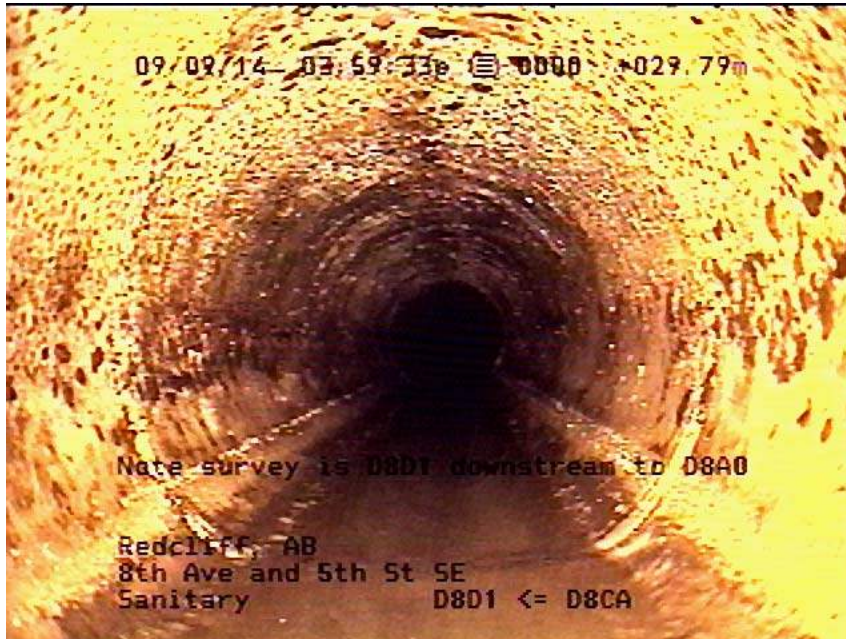
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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/9/2014
<b>Inspection no.:</b> A14-135-04	<b>Address:</b> 8th Ave and 5th St SE	<b>Sewer:</b> D8CA	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D1	<b>Total length:</b> 29.79 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8CA	<b>Page:</b> 13
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Not cleaned

## sewer inspection



**Photo** : 3

**Distance** : 29.79 m

**Video** : 00:00:00

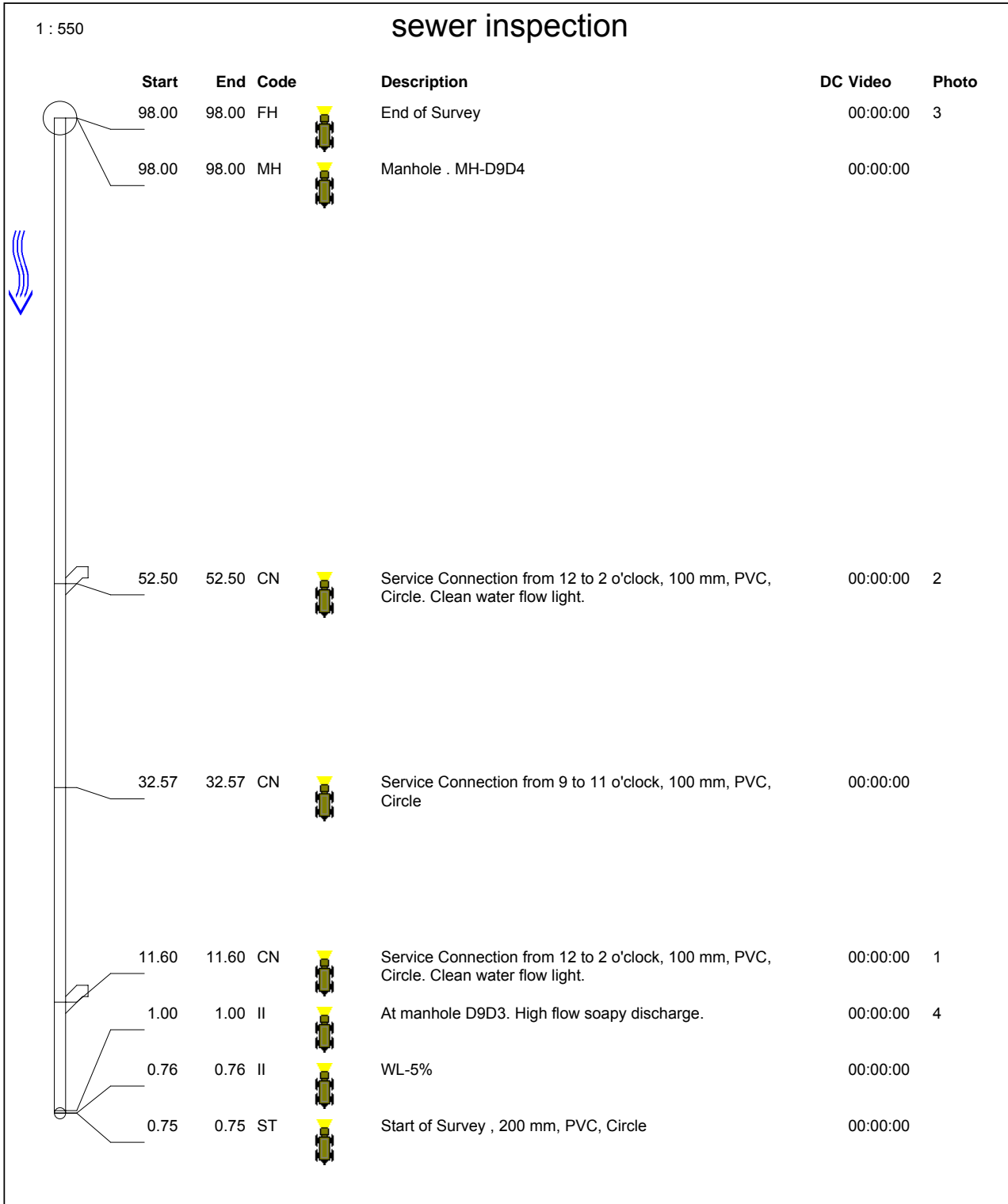
**DC** :

**Code** : II

Note survey is D8D1

downstream to D8A0

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-05	<b>Address:</b> 4th St and 4th Ave NW	<b>Sewer:</b> D9D3	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D9D4	<b>Total length:</b> 98.00 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D9D3	<b>Page:</b> 14
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-05	<b>Address:</b> 4th St and 4th Ave NW	<b>Sewer:</b> D9D3	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D9D4	<b>Total length:</b> 98.00 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D9D3	<b>Page:</b> 15
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

## sewer inspection

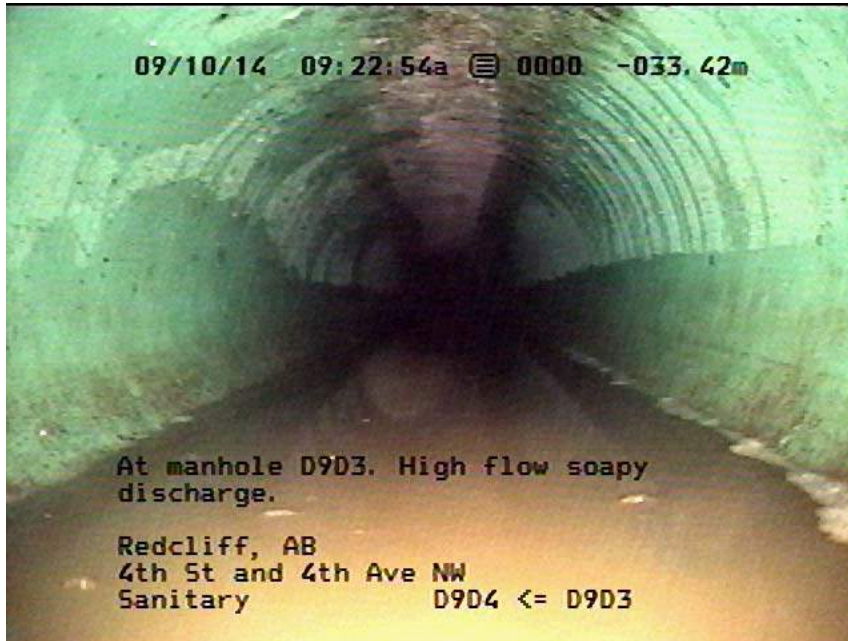


Photo : 4  
Distance : 1.00 m  
Video : 00:00:00  
DC :  
Code : II  
At manhole D9D3. High flow soapy discharge.



Photo : 1  
Distance : 11.60 m  
Video : 00:00:00  
DC :  
Code : CN  
Service Connection from 12 to 2 o'clock, 100 mm, PVC, Circle. Clean water flow light.



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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-05	<b>Address:</b> 4th St and 4th Ave NW	<b>Sewer:</b> D9D3	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D9D4	<b>Total length:</b> 98.00 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D9D3	<b>Page:</b> 16
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

## sewer inspection



**Photo** : 2

**Distance** : 52.50 m

**Video** : 00:00:00

**DC** :

**Code** : CN

Service Connection from  
12 to 2 o'clock, 100 mm,  
PVC, Circle. Clean water  
flow light.



**Photo** : 3

**Distance** : 98.00 m

**Video** : 00:00:00

**DC** :

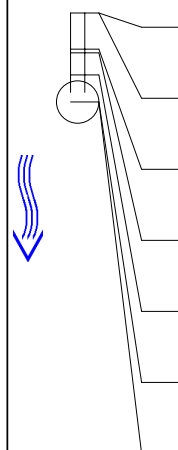
**Code** : FH

End of Survey

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-06	<b>Address:</b> 4th St and 4th Ave NW	<b>Sewer:</b> D9D4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D9D4	<b>Total length:</b> 7.64 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D9D5	<b>Page:</b> 17
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	0.75	0.75	ST	Start of Survey , 200 mm, PVC, Circle	00:00:00	
	0.75	0.75	II	WL-5%	00:00:00	
	3.55	3.55	LR	Line Deviation Right	00:00:00	
	3.84	3.84	JL	Joint Displacement Light	00:00:00	
	5.54	5.54	BL	Debris Light - Sewer flow not affected	00:00:00	
	7.64	7.64	MH	Manhole . MH-D9D5	00:00:00	
	7.64	7.64	FH	End of Survey	00:00:00	

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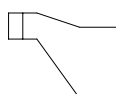
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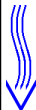


<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-07	<b>Address:</b> 4th St and 4th Ave NW	<b>Sewer:</b> D9D6	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D9D6	<b>Total length:</b>
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D9D5	<b>Page:</b> 18
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

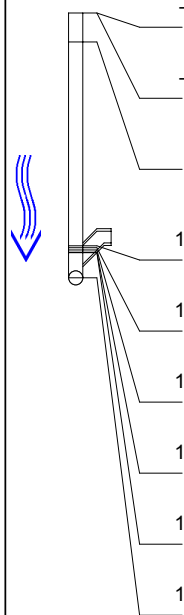
	Start	End	Code	Description	DC Video	Photo
	-1.27	-1.27	II	WL-30%	00:00:00	
	0.75	0.75	ST	Start of Survey , 200 mm, PVC, Circle	00:00:00	



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-08	<b>Address:</b> Stone PI and 5th Ave SW	<b>Sewer:</b> D966	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D966	<b>Total length:</b> 19.00 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D964	<b>Page:</b> 19
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	-1.50	-1.50	II		00:00:00	
	-1.50	-1.50	II	WL-5%	00:00:00	
	0.75	0.75	ST	Start of Survey , 200 mm, PVC, Circle	00:00:00	
	16.52	16.52	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	1
	16.67	16.67	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC	00:00:00	
	16.85	16.85	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	17.02	17.02	BM	Debris Moderate - < 25% flow area restriction from 5 to 7 o'clock. Rocks	00:00:00	2
	17.05	17.05	CN	Service Connection from 10 to 12 o'clock, 100 mm, PVC, Circle	00:00:00	
	19.00	19.00	FH	End of Survey . Unable to pass debris.	00:00:00	



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-08	<b>Address:</b> Stone Pl and 5th Ave SW	<b>Sewer:</b> D966	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D966	<b>Total length:</b> 19.00 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D964	<b>Page:</b> 20
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

## sewer inspection



**Photo** : 1  
**Distance** : 16.52 m  
**Video** : 00:00:00  
**DC** :  
**Code** : CN  
Service Connection from  
1 to 3 o'clock, 100 mm,  
PVC, Circle



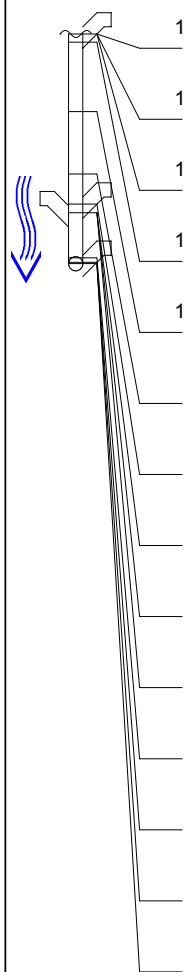














**Photo** : 2  
**Distance** : 17.02 m  
**Video** : 00:00:00  
**DC** :  
**Code** : BM  
Debris Moderate - < 25%  
flow area restriction from 5  
to 7 o'clock. Rocks



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-08R	<b>Address:</b> Stone PI and 5th Ave SW	<b>Sewer:</b> D966	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D964	<b>Total length:</b> 19.00 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D966	<b>Page:</b> 21
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

1 : 550

## sewer inspection

	Start	End	Code		Description	DC Video	Photo
	18.53	18.53	FH		End of Survey . Unable to pass debris.	00:00:00	
	18.53	18.53	BM		Debris Moderate - < 25% flow area restriction from 5 to 7 o'clock. Rocks/Gravel in pipe	00:00:00	3
	18.53	18.53	CN		Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	17.89	17.89	CN		Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	12.52	12.52	II		WL-5%	00:00:00	
	7.69	7.69	II		WL-15%	00:00:00	
	5.36	5.36	CN		Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	4.69	4.69	SM		Sag Moderate	00:00:00	2
	4.69	4.69	II		WL-40%	00:00:00	
	4.69	4.69	CN		Service Connection from 8 to 10 o'clock, 100 mm, PVC, Circle	00:00:00	
	1.20	1.20	CN		Service Connection from 10 to 12 o'clock, 100 mm, PVC, Circle	00:00:00	
	0.85	0.85	CN		Service Connection from 12 to 2 o'clock, 100 mm, PVC, Circle. Clear water flow light.	00:00:00	1
	0.75	0.75	II		WL-15%	00:00:00	
	0.75	0.75	ST		Start of Survey , 200 mm, PVC, Circle	00:00:00	

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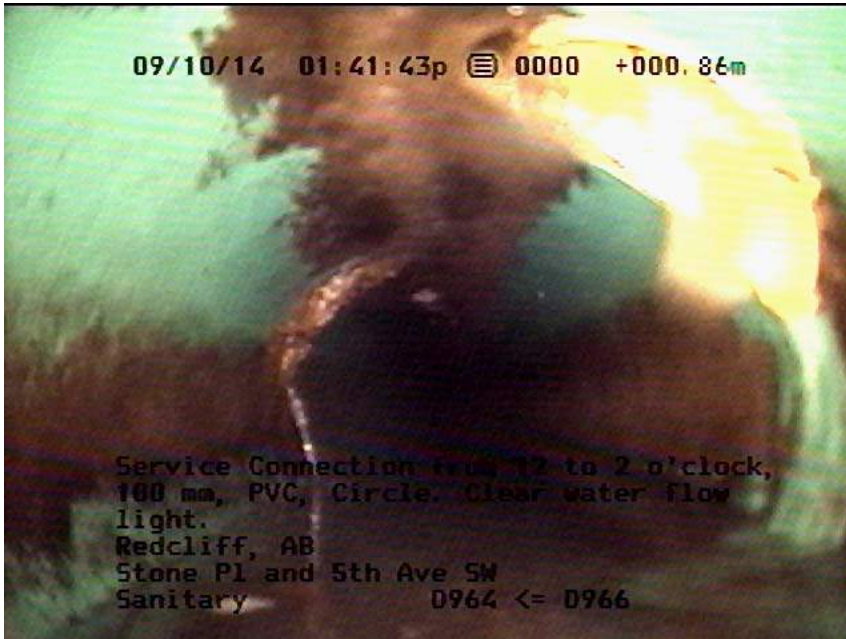
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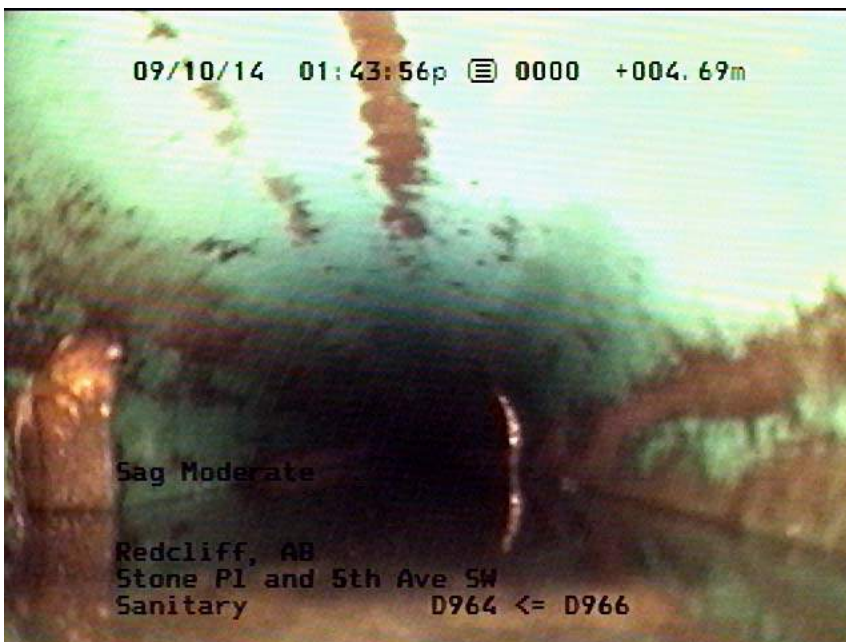


<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-08R	<b>Address:</b> Stone Pl and 5th Ave SW	<b>Sewer:</b> D966	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D964	<b>Total length:</b> 19.00 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D966	<b>Page:</b> 22
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

## sewer inspection



**Photo** : 1  
**Distance** : 0.85 m  
**Video** : 00:00:00  
**DC** :  
**Code** : CN  
Service Connection from  
12 to 2 o'clock, 100 mm,  
PVC, Circle. Clear water  
flow light.



**Photo** : 2  
**Distance** : 4.69 m  
**Video** : 00:00:00  
**DC** :  
**Code** : SM  
Sag Moderate

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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-08R	<b>Address:</b> Stone Pl and 5th Ave SW	<b>Sewer:</b> D966	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D964	<b>Total length:</b> 19.00 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D966	<b>Page:</b> 23
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

## sewer inspection



Photo : 3

Distance : 18.53 m

Video : 00:00:00

DC :

Code : BM

Debris Moderate - < 25%  
flow area restriction from 5  
to 7 o'clock.  
Rocks/Gravel in pipe

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/10/2014
<b>Inspection no.:</b> A14-135-09	<b>Address:</b> Stone PI and 5th Ave SW	<b>Sewer:</b> D964	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D964	<b>Total length:</b> 73.55 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D99D	<b>Page:</b> 24
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

1 : 550












## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	0.75	0.75	ST	Start of Survey , 200 mm, PVC, Circle	00:00:00	
	0.75	0.75	II	WL-10%	00:00:00	
	19.57	19.57	II	WL-25%	00:00:00	
	22.92	22.92	SM	Sag Moderate	00:00:00	
	24.49	24.49	II	WL-15%	00:00:00	
	27.00	27.00	II	WL-5%	00:00:00	
	73.55	73.55	MH	Manhole . MH-D99D	00:00:00	
	73.55	73.55	FH	End of Survey	00:00:00	

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-10	<b>Address:</b> Alley 6th and 1st SE	<b>Sewer:</b> D99D	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D969	<b>Total length:</b> 44.03 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D99D	<b>Page:</b> 25
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

1 : 550

## sewer inspection

	Start	End	Code		Description	DC Video	Photo
	44.03	44.03	FH		End of Survey	00:00:00	
	44.03	44.03	MH		Manhole . MH-D99D	00:00:00	
	44.03	44.03	II		Manhole lid displaced	00:00:00	1
	27.67	27.67	II		WL-10%	00:00:00	
	24.50	24.50	II		WL-15%	00:00:00	
	13.34	13.34	II		WL-5%	00:00:00	
	7.22	7.22	II		WL-10%	00:00:00	
	6.78	6.78	SL		Sag Light	00:00:00	
	2.69	2.69	II		WL-10%	00:00:00	
	0.75	0.75	II		WL-5%	00:00:00	
	0.75	0.75	ST		Start of Survey , 200 mm, PVC, Circle	00:00:00	

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<b>Inspection no.:</b> A14-135-10	<b>Address:</b> Alley 6th and 1st SE	<b>Sewer:</b> D99D	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D969	<b>Total length:</b> 44.03 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D99D	<b>Page:</b> 26
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> PVC	<b>Condition:</b> Cleaned

## sewer inspection

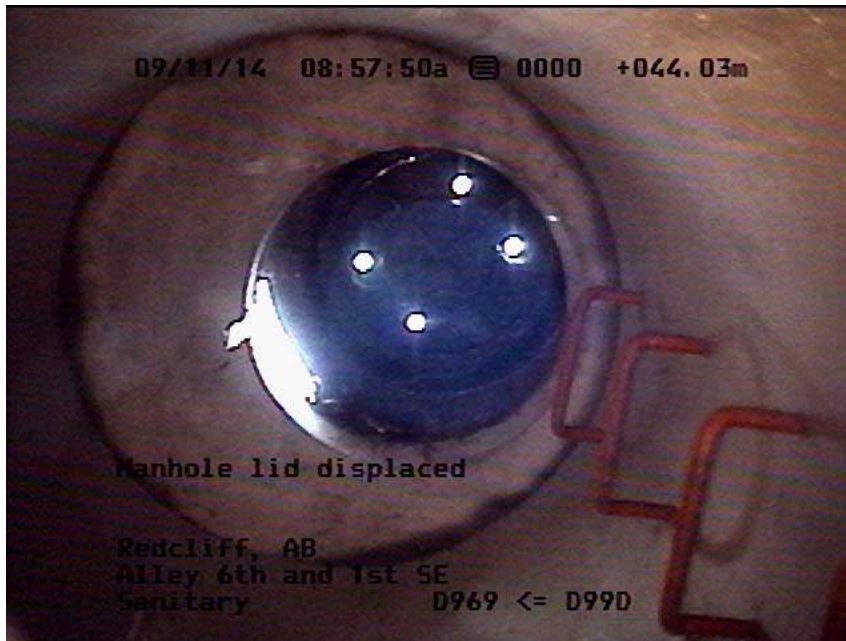


Photo : 1  
Distance : 44.03 m  
Video : 00:00:00  
DC :  
Code : II  
Manhole lid displaced



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-11	<b>Address:</b> 6th Ave and 6th St SE	<b>Sewer:</b> D8D5	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D5	<b>Total length:</b> 17.13 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8F6	<b>Page:</b> 27
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Cleaned

1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	-1.77	-1.77	II	WL-5%	00:00:00	
	-1.65	-1.65	II	Note add 1.65 meters to chainage.	00:00:00	
	0.75	0.75	ST	Start of Survey , 200 mm, TP Clay Tile Pipe, Circle	00:00:00	
	1.50	1.50	JM	Joint Displacement Moderate from 4 to 8 o'clock	00:00:00	1
	1.50	1.50	EM	Encrustation Moderate - < 25% flow area restriction from 9 to 3 o'clock	00:00:00	
	1.85	1.85	II	WL-30%	00:00:00	
	3.06	3.06	II	WL-5%	00:00:00	
	13.20	13.20	CN	Service Connection from 8 to 10 o'clock, 100 mm, PVC, Circle	00:00:00	2
	15.52	15.52	LD	Line Deviation Down	00:00:00	
	17.07	17.07	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	17.13	17.13	EM	Encrustation Moderate - < 25% flow area restriction	00:00:00	
	17.13	17.13	FH	End of Survey . Unable to pass protruding connection.	00:00:00	

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-11	<b>Address:</b> 6th Ave and 6th St SE	<b>Sewer:</b> D8D5	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D5	<b>Total length:</b> 17.13 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8F6	<b>Page:</b> 28
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Cleaned

## sewer inspection

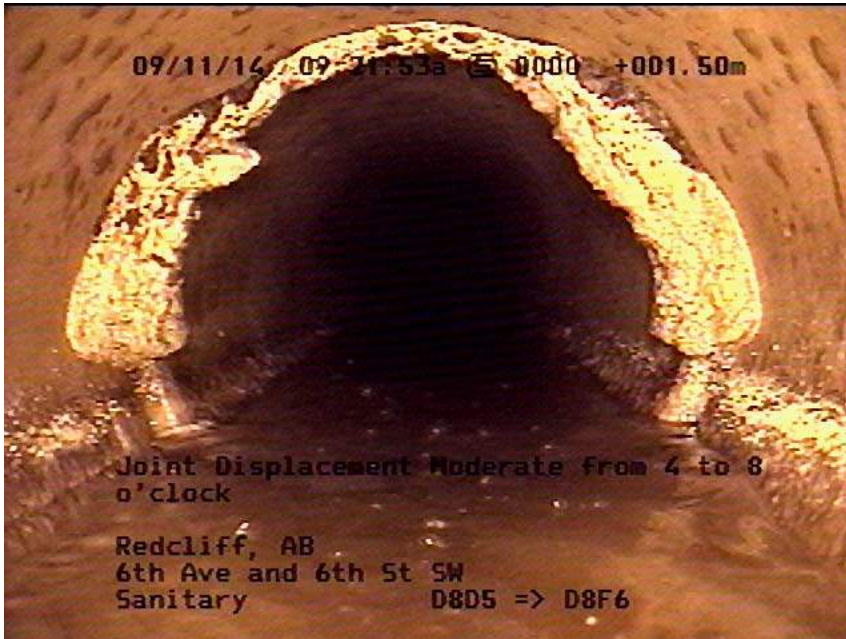


Photo : 1  
Distance : 1.50 m  
Video : 00:00:00  
DC :  
Code : JM  
Joint Displacement  
Moderate from 4 to 8  
o'clock



Photo : 2  
Distance : 13.20 m  
Video : 00:00:00  
DC :  
Code : CN  
Service Connection from  
8 to 10 o'clock, 100 mm,  
PVC, Circle



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<b>Inspection no.:</b> A14-135-12	<b>Address:</b> 6th Ave and 7th Steet SE	<b>Sewer:</b> D8D4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D4	<b>Total length:</b> 99.76 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8F5	<b>Page:</b> 29
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Cleaned

1 : 550

**sewer inspection**

	Start	End	Code	Description	DC Video	Photo
	0.75	0.75	ST	Start of Survey , 200 mm, TP Clay Tile Pipe, Circle	00:00:00	
	0.75	0.75	II	WL-5%	00:00:00	
	3.37	3.37	DM	Deformation Moderate	00:00:00	1
	5.63	5.63	LD	Line Deviation Down	00:00:00	
	9.19	9.19	II	Pipe is asbestos cement	00:00:00	2
	13.36	13.36	BS	Debris Severe - > 25% flow area restriction from 2 to 6 o'clock	00:00:00	3
	13.36	13.36	FH	End of Survey . Unable to pass debris	00:00:00	

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<b>Inspection no.:</b> A14-135-12	<b>Address:</b> 6th Ave and 7th Steet SE	<b>Sewer:</b> D8D4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D4	<b>Total length:</b> 99.76 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8F5	<b>Page:</b> 30
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Cleaned

## sewer inspection



Photo : 1  
Distance : 3.37 m  
Video : 00:00:00  
DC :  
Code : DM  
Deformation Moderate



Photo : 2  
Distance : 9.19 m  
Video : 00:00:00  
DC :  
Code : II  
Pipe is asbestos cement

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<b>Inspection no.:</b> A14-135-12	<b>Address:</b> 6th Ave and 7th Steet SE	<b>Sewer:</b> D8D4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D4	<b>Total length:</b> 99.76 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8F5	<b>Page:</b> 31
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Cleaned

## sewer inspection



**Photo** : 3

**Distance** : 13.36 m

**Video** : 00:00:00

**DC** :



















**Code** : BS

Debris Severe - > 25%  
flow area restriction from 2  
to 6 o'clock

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-12R	<b>Address:</b> 6th Ave and 7th Steet SE	<b>Sewer:</b> D8D4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8F5	<b>Total length:</b> 99.76 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8D4	<b>Page:</b> 32
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Cleaned

1 : 550

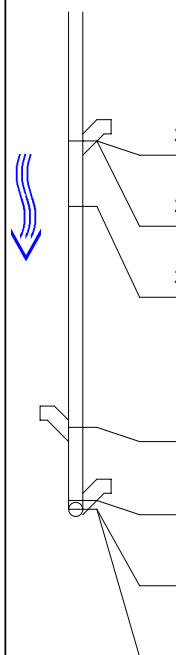
## sewer inspection

	Start	End	Code		Description	DC Video	Photo
	99.76	99.76	FH		End of Survey	00:00:00	
	99.76	99.76	BS		Debris Severe - > 25% flow area restriction	00:00:00	5
	99.76	99.76	DM		Deformation Moderate	00:00:00	
	99.45	99.45	JM		Joint Displacement Moderate from 7 to 11 o'clock	00:00:00	4
	98.69	98.69	CN		Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	94.98	94.98	CN		Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle. Clean water flow light.	00:00:00	3
	86.76	86.76	II		WL-5%	00:00:00	
	83.94	83.94	CN		Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	78.40	78.40	SL		Sag Light	00:00:00	2
	78.40	78.40	II		WL-15%	00:00:00	
	78.40	78.40	CN		Service Connection from 8 to 10 o'clock, 100 mm, PVC, Circle	00:00:00	
	72.58	72.58	CN		Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	69.53	69.53	EL		Encrustation Light - Sewer flow not affected	00:00:00	
	69.52	69.52	CN		Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	60.83	60.83	CN		Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	53.97	53.97	CN		Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	49.80	49.80	CN		Service Connection from 2 to 4 o'clock, 100 mm, PVC, Circle	00:00:00	
	39.25	39.25	CN		Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-12R	<b>Address:</b> 6th Ave and 7th Steet SE	<b>Sewer:</b> D8D4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8F5	<b>Total length:</b> 99.76 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8D4	<b>Page:</b> 33
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Cleaned

1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	29.26	29.26	RL	Roots Light - Sewer flow not affected from 1 to 3 o'clock	00:00:00	
	29.26	29.26	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	1
	24.20	24.20	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	7.10	7.10	CN	Service Connection from 8 to 10 o'clock, 100 mm, PVC, Circle	00:00:00	
	1.44	1.44	CN	Service Connection from 2 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	0.75	0.75	II	WL-5%	00:00:00	
	0.75	0.75	ST	Start of Survey , 200 mm, ACP Asbestos Cement Pipe, Circle	00:00:00	



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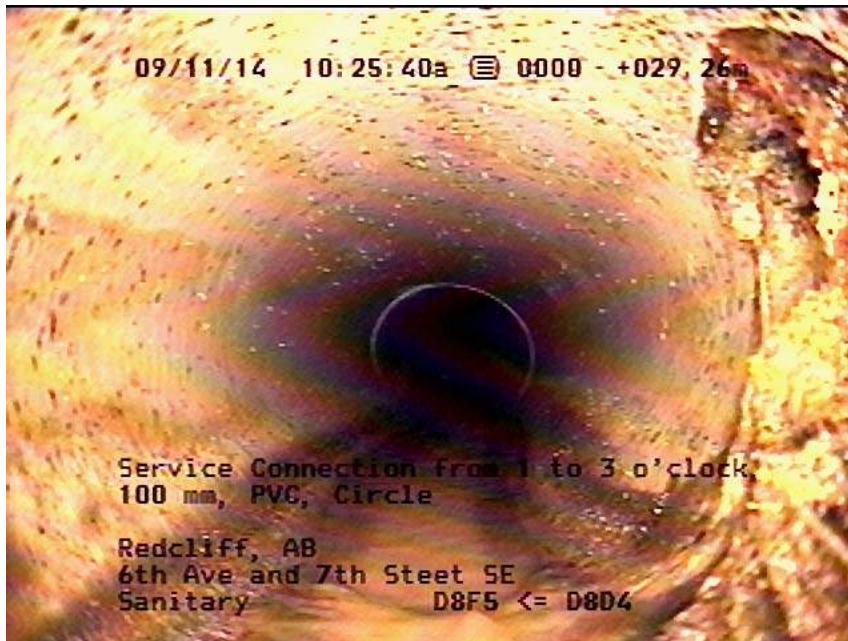
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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-12R	<b>Address:</b> 6th Ave and 7th Steet SE	<b>Sewer:</b> D8D4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8F5	<b>Total length:</b> 99.76 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8D4	<b>Page:</b> 34
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Cleaned

## sewer inspection



**Photo** : 1  
**Distance** : 29.26 m  
**Video** : 00:00:00  
**DC** :  
**Code** : CN  
Service Connection from  
1 to 3 o'clock, 100 mm,  
PVC, Circle



**Photo** : 2  
**Distance** : 78.40 m  
**Video** : 00:00:00  
**DC** :  
**Code** : SL  
Sag Light

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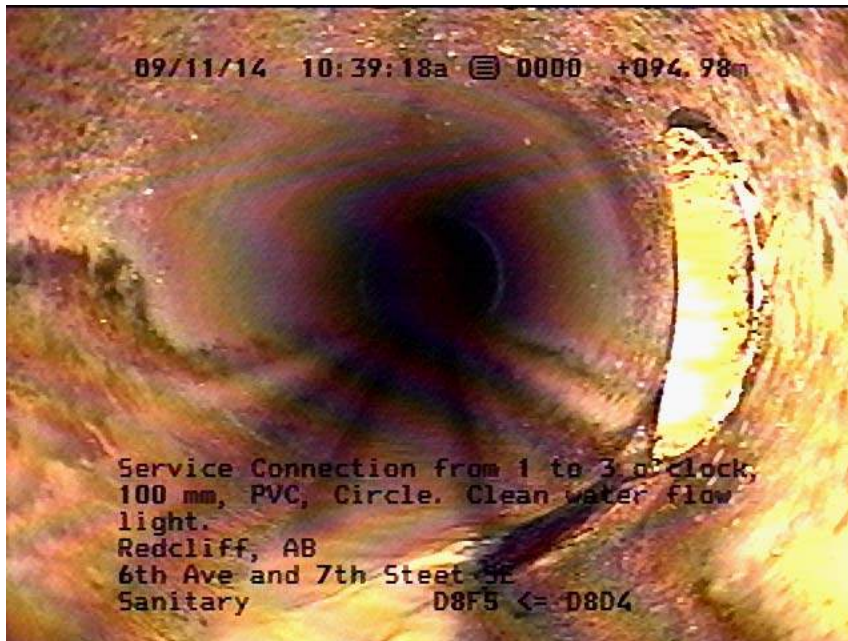
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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-12R	<b>Address:</b> 6th Ave and 7th Steet SE	<b>Sewer:</b> D8D4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8F5	<b>Total length:</b> 99.76 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8D4	<b>Page:</b> 35
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Cleaned

## sewer inspection



**Photo** : 3  
**Distance** : 94.98 m  
**Video** : 00:00:00  
**DC** :  
**Code** : CN  
Service Connection from  
1 to 3 o'clock, 100 mm,  
PVC, Circle. Clean water  
flow light.



**Photo** : 4  
**Distance** : 99.45 m  
**Video** : 00:00:00  
**DC** :  
**Code** : JM  
Joint Displacement  
Moderate from 7 to 11  
o'clock



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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-12R	<b>Address:</b> 6th Ave and 7th Steet SE	<b>Sewer:</b> D8D4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8F5	<b>Total length:</b> 99.76 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8D4	<b>Page:</b> 36
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Cleaned

## sewer inspection



Photo : 5  
Distance : 99.76 m  
Video : 00:00:00  
DC :  
Code : BS  
Debris Severe - > 25%  
flow area restriction



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-13	<b>Address:</b> 623 7th Steet SE	<b>Sewer:</b> D8F5	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8F5	<b>Total length:</b> 76.90 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8F4	<b>Page:</b> 37
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Cleaned

1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	0.75	0.75	ST	Start of Survey , 200 mm, ACP Asbestos Cement Pipe, Circle	00:00:00	
	0.75	0.75	II	WL-5%	00:00:00	
	3.33	3.33	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	3.55	3.55	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	4.84	4.84	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	14.26	14.26	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	22.95	22.95	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	29.15	29.15	DM	Deformation Moderate	00:00:00	1
	29.35	29.35	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	29.87	29.87	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	30.94	30.94	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	50.57	50.57	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	50.91	50.91	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	70.82	70.82	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	75.20	75.20	LD	Line Deviation Down	00:00:00	
	76.91	76.91	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	79.51	79.51	MH	Manhole . MH-D8F4	00:00:00	
	79.51	79.51	FH	End of Survey	00:00:00	

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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-13	<b>Address:</b> 623 7th Steet SE	<b>Sewer:</b> D8F5	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8F5	<b>Total length:</b> 76.90 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8F4	<b>Page:</b> 38
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Cleaned

## sewer inspection



**Photo** : 1  
**Distance** : 29.15 m  
**Video** : 00:00:00  
**DC** :  
**Code** : DM  
Deformation Moderate

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-14	<b>Address:</b> 646 7th Steet SE	<b>Sewer:</b> D8F4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8F4	<b>Total length:</b> 109.55 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8E9	<b>Page:</b> 39
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	0.75	0.75	ST	Start of Survey , 200 mm, ACP Asbestos Cement Pipe, Circle	00:00:00	
	0.75	0.75	II	WL-5%	00:00:00	
	3.09	3.09	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	12.04	12.04	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	20.85	20.85	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	28.63	28.63	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	36.65	36.65	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	43.03	43.03	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	50.42	50.42	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	58.84	58.84	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	60.84	60.84	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	62.85	62.85	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	75.79	75.79	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	76.73	76.73	DM	Deformation Moderate	00:00:00	1
	78.08	78.08	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	93.96	93.96	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	

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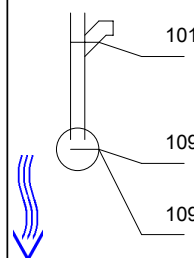


<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-14	<b>Address:</b> 646 7th Steet SE	<b>Sewer:</b> D8F4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8F4	<b>Total length:</b> 109.55 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8E9	<b>Page:</b> 40
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

Start	End	Code	Description	DC Video	Photo
101.27	101.27	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
109.55	109.55	MH	Manhole . MH-D8E9	00:00:00	
109.55	109.55	FH	End of Survey	00:00:00	



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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-14	<b>Address:</b> 646 7th Steet SE	<b>Sewer:</b> D8F4	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8F4	<b>Total length:</b> 109.55 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8E9	<b>Page:</b> 41
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> ACP Asbestos Ceme	<b>Condition:</b> Not cleaned

## sewer inspection

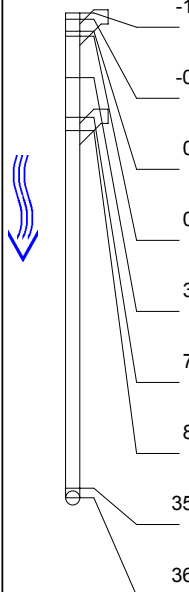


Photo : 1  
Distance : 76.73 m  
Video : 00:00:00  
DC :  
Code : DM  
Deformation Moderate

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-15	<b>Address:</b> 735 7th Steet SE	<b>Sewer:</b> D8E9	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8E9	<b>Total length:</b> 36.48 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8D3	<b>Page:</b> 42
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	-1.05	-1.05	II	WL-5%	00:00:00	
	-0.56	-0.56	OM	Open Joint Moderate	00:00:00	1
	0.36	0.36	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	0.75	0.75	ST	Start of Survey , 200 mm, TP Clay Tile Pipe, Circle	00:00:00	
	3.96	3.96	II	WL-10%	00:00:00	
	7.03	7.03	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	8.05	8.05	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	35.74	35.74	EM	Encrustation Moderate - < 25% flow area restriction	00:00:00	2
	36.48	36.48	FH	End of Survey . Sag - Unable to pass debris. WL - 25%	00:00:00	3

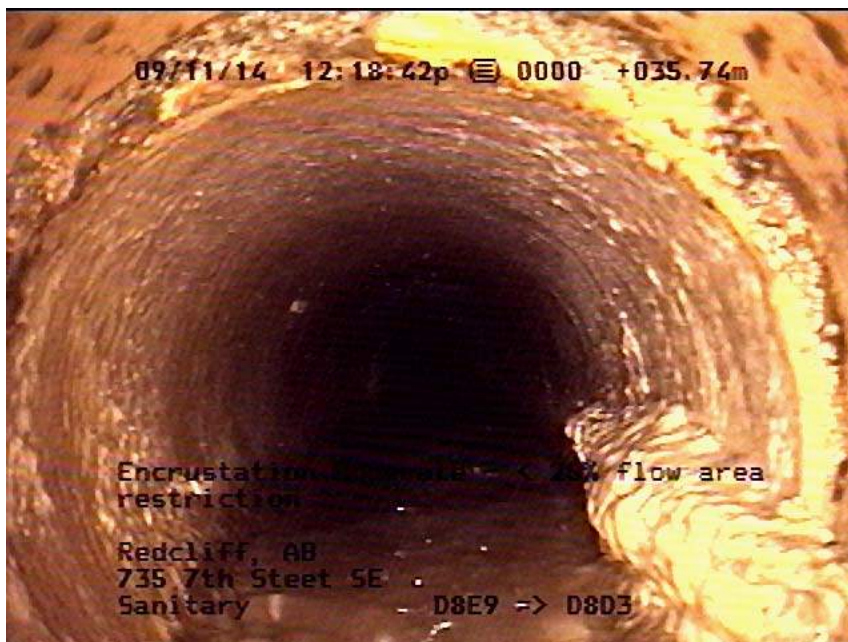


<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-15	<b>Address:</b> 735 7th Steet SE	<b>Sewer:</b> D8E9	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8E9	<b>Total length:</b> 36.48 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8D3	<b>Page:</b> 43
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

## sewer inspection



**Photo** : 1  
**Distance** : -0.56 m  
**Video** : 00:00:00  
**DC** :  
**Code** : OM  
Open Joint Moderate



**Photo** : 2  
**Distance** : 35.74 m  
**Video** : 00:00:00  
**DC** :  
**Code** : EM  
Encrustation Moderate -  
< 25% flow area restriction

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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-15	<b>Address:</b> 735 7th Steet SE	<b>Sewer:</b> D8E9	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8E9	<b>Total length:</b> 36.48 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8D3	<b>Page:</b> 44
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

## sewer inspection



**Photo** : 3

**Distance** : 36.48 m

**Video** : 00:00:00

**DC** :

**Code** : FH

End of Survey . Sag -

Unable to pass debris.

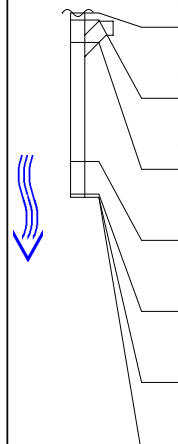







WL - 25%



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-15R	<b>Address:</b> 735 7th Steet SE	<b>Sewer:</b> D8E9	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D3	<b>Total length:</b> 36.48 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8E9	<b>Page:</b> 45
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

	Start	End	Code		Description	DC Video	Photo
	15.02	15.02	FH		End of Survey . Undable to continue camera underwater.	00:00:00	
	14.47	14.47	SM		Sag Moderate . WL-40%	00:00:00	
	12.74	12.74	CN		Service Connection from 2 to 4 o'clock, 100 mm, PVC, Circle	00:00:00	
	3.52	3.52	II		WL-5%	00:00:00	
	1.00	1.00	SM		Sag Moderate	00:00:00	
	0.75	0.75	II		WL-40%	00:00:00	
	0.75	0.75	ST		Start of Survey , 200 mm, TP Clay Tile Pipe, Circle	00:00:00	

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-16	<b>Address:</b> 813 7th Steet SE	<b>Sewer:</b> D8D3	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D3	<b>Total length:</b> 60.50 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D89F	<b>Page:</b> 46
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

1 : 550

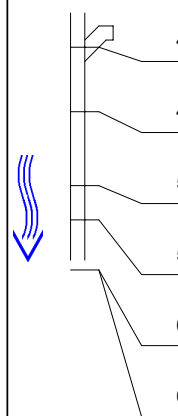
## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	0.75	0.75	ST	Start of Survey , 200 mm, TP Clay Tile Pipe, Circle	00:00:00	
	0.75	0.75	II	WL-25%	00:00:00	
	1.50	1.50	SM	Sag Moderate	00:00:00	
	2.38	2.38	II	WL-5%	00:00:00	
	5.08	5.08	OM	Open Joint Moderate from 9 to 1 o'clock	00:00:00	1
	8.39	8.39	CN	Service Connection from 8 to 10 o'clock, 100 mm, PVC, Circle	00:00:00	
	8.39	8.39	II	WL-30%	00:00:00	2
	11.60	11.60	CN	Service Connection from 2 to 4 o'clock, 100 mm, PVC, Circle	00:00:00	
	14.71	14.71	II	WL-5%	00:00:00	
	25.90	25.90	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	
	27.82	27.82	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	29.45	29.45	II	WL-30%	00:00:00	
	29.89	29.89	SM	Sag Moderate	00:00:00	3
	30.43	30.43	EM	Encrustation Moderate - < 25% flow area restriction from 2 to 5 o'clock	00:00:00	4
	32.07	32.07	SM	Sag Moderate . WL-25%	00:00:00	
	37.59	37.59	LD	Line Deviation Down	00:00:00	
	40.32	40.32	EM	Encrustation Moderate - < 25% flow area restriction	00:00:00	5
	41.40	41.40	CN	Service Connection from 1 to 3 o'clock, 100 mm, PVC, Circle	00:00:00	

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-16	<b>Address:</b> 813 7th Steet SE	<b>Sewer:</b> D8D3	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D3	<b>Total length:</b> 60.50 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D89F	<b>Page:</b> 47
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	43.30	43.30	CN	Service Connection from 9 to 11 o'clock, 100 mm, PVC, Circle	00:00:00	
	48.30	48.30	SM	Sag Moderate . WL-25%	00:00:00	
	54.01	54.01	II	WL-5%	00:00:00	
	56.66	56.66	II	High water line mark sign of surcharge.	00:00:00	6
	60.54	60.54	BM	Debris Moderate - < 25% flow area restriction . Debris blockage in bottom of pipe - unable to continue.	00:00:00	
	60.54	60.54	FH	End of Survey	00:00:00	

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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-16	<b>Address:</b> 813 7th Steet SE	<b>Sewer:</b> D8D3	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D3	<b>Total length:</b> 60.50 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D89F	<b>Page:</b> 48
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

## sewer inspection

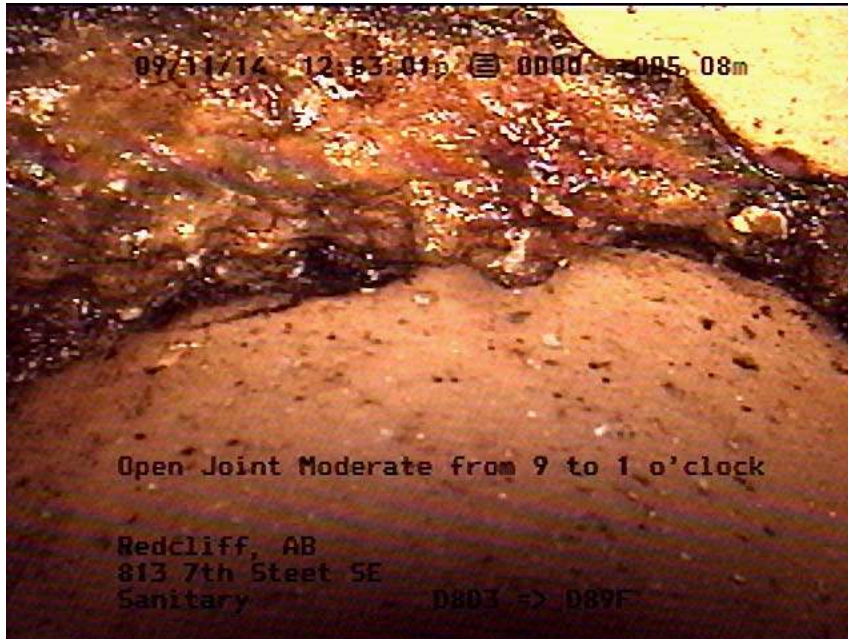


Photo : 1  
Distance : 5.08 m  
Video : 00:00:00  
DC :  
Code : OM  
Open Joint Moderate from  
9 to 1 o'clock

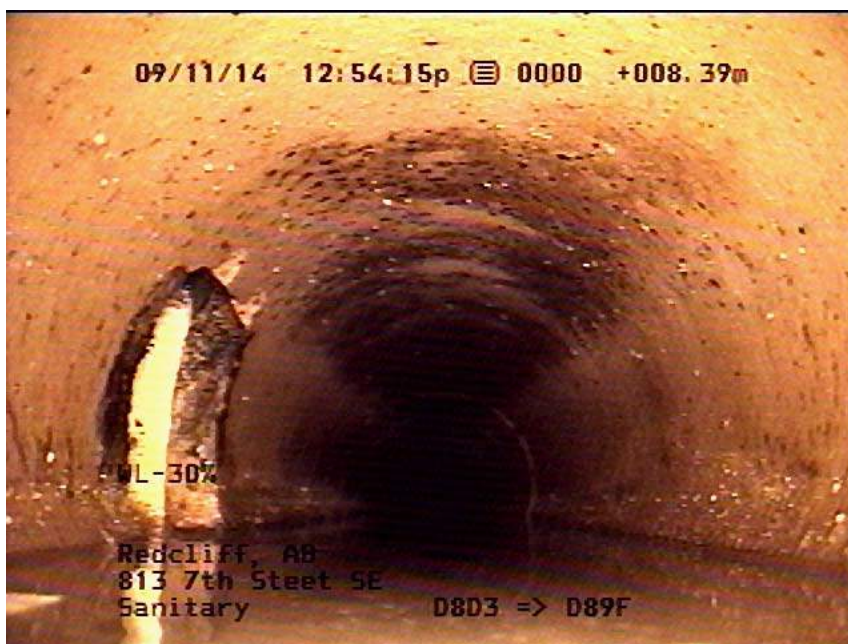


Photo : 2  
Distance : 8.39 m  
Video : 00:00:00  
DC :  
Code : II  
WL-30%



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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-16	<b>Address:</b> 813 7th Steet SE	<b>Sewer:</b> D8D3	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D3	<b>Total length:</b> 60.50 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D89F	<b>Page:</b> 49
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

## sewer inspection



Photo : 3  
Distance : 29.89 m  
Video : 00:00:00  
DC :  
Code : SM  
Sag Moderate

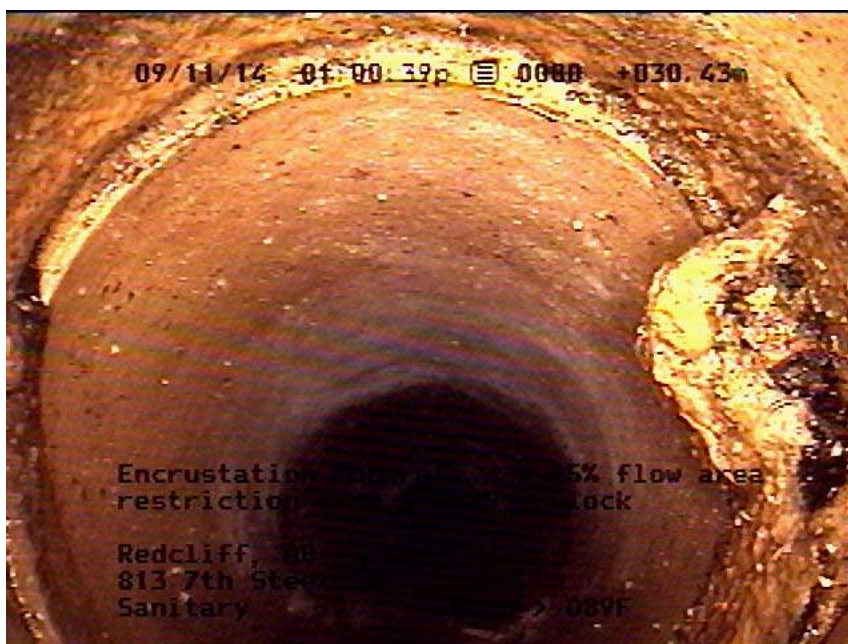


Photo : 4  
Distance : 30.43 m  
Video : 00:00:00  
DC :  
Code : EM  
Encrustation Moderate -  
< 25% flow area restriction  
from 2 to 5 o'clock

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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-16	<b>Address:</b> 813 7th Steet SE	<b>Sewer:</b> D8D3	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8D3	<b>Total length:</b> 60.50 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D89F	<b>Page:</b> 50
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

## sewer inspection



Photo : 5  
Distance : 40.32 m  
Video : 00:00:00  
DC :  
Code : EM  
Encrustation Moderate -  
< 25% flow area restriction

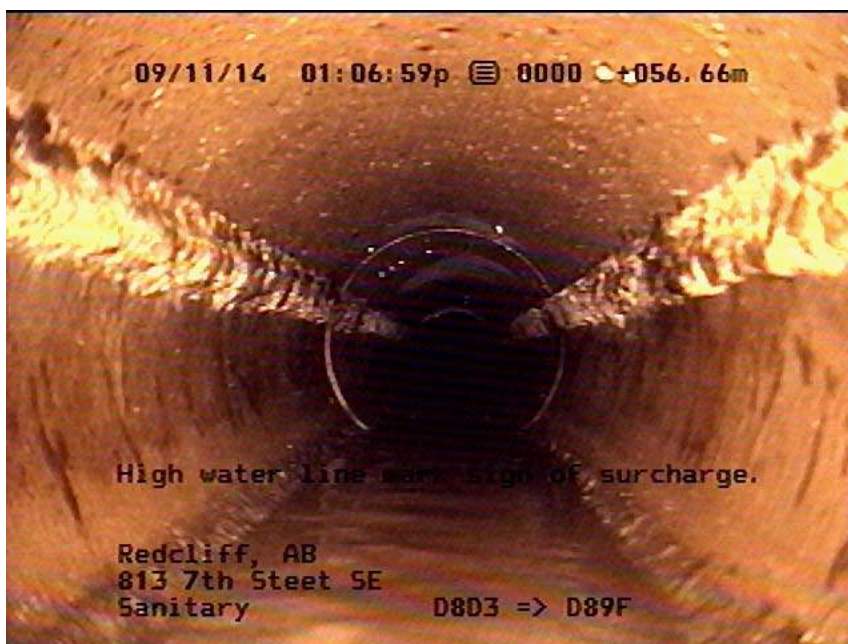
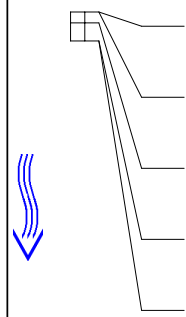







Photo : 6  
Distance : 56.66 m  
Video : 00:00:00  
DC :  
Code : II  
High water line mark sign  
of surcharge.

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-16R	<b>Address:</b> 813 7th Steet SE	<b>Sewer:</b> D8D3	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D89F	<b>Total length:</b> 60.50 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8D3	<b>Page:</b> 51
<b>Profile:</b> Circle / 200 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection








	Start	End	Code		Description	DC Video	Photo
	3.00	3.00	FH		End of Survey	00:00:00	
	3.00	3.00	SS		Sag Severe . Camera underwater	00:00:00	
	2.16	2.16	II		WL-40%	00:00:00	
	0.75	0.75	II		WL-5%	00:00:00	
	0.75	0.75	ST		Start of Survey , 200 mm, TP Clay Tile Pipe, Circle	00:00:00	



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-17	<b>Address:</b> Main and 6th Ave SE	<b>Sewer:</b> D8DE-1	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8DD	<b>Total length:</b> 15.72 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8DE-1	<b>Page:</b> 52
<b>Profile:</b> Circle / 300 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

	Start	End	Code		Description	DC Video	Photo
	15.72	15.72	FH		End of Survey . Too much debris to pass.	00:00:00	
	13.01	13.01	BM		Debris Moderate - < 25% flow area restriction	00:00:00	
	7.96	7.96	EL		Encrustation Light - Sewer flow not affected from 9 to 3 o'clock	00:00:00	
	7.73	7.73	II		WL-15%	00:00:00	
	2.58	2.58	CN		Service Connection from 12 to 2 o'clock, 100 mm, PVC, Circle	00:00:00	
	0.75	0.75	II		WL-25%	00:00:00	
	0.75	0.75	ST		Start of Survey , 300 mm, TP Clay Tile Pipe, Circle	00:00:00	

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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-18	<b>Address:</b> 618 Main St.	<b>Sewer:</b> D8DD	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8DD	<b>Total length:</b> 6.43 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8EA	<b>Page:</b> 53
<b>Profile:</b> Circle / 300 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

1 : 550

## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	0.75	0.75	ST	Start of Survey , 300 mm, TP Clay Tile Pipe, Circle	00:00:00	
	0.75	0.75	II	WL-10%	00:00:00	
	2.23	2.23	JS	Joint Displacement Revere	00:00:00	1

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Fax # 780-443-4613



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/11/2014
<b>Inspection no.:</b> A14-135-18	<b>Address:</b> 618 Main St.	<b>Sewer:</b> D8DD	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8DD	<b>Total length:</b> 6.43 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8EA	<b>Page:</b> 54
<b>Profile:</b> Circle / 300 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Not cleaned

## sewer inspection



**Photo** : 1  
**Distance** : 2.23 m  
**Video** : 00:00:00  
**DC** :  
**Code** : JS  
Joint Displacement  
Revere



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<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/12/2014
<b>Inspection no.:</b> A14-135-18R	<b>Address:</b> 618 Main St.	<b>Sewer:</b> D8DD	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8EA	<b>Total length:</b> 6.43 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Upstream	<b>End Manhole:</b> D8DD	<b>Page:</b> 56
<b>Profile:</b> Circle / 300 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Cleaned

## sewer inspection



**Photo** : 1

**Distance** : 6.43 m

**Video** : 00:00:00

**DC** :

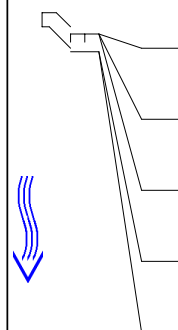
**Code** : BM

Debris Moderate - < 25%  
flow area restriction .  
Unable to pass gravel  
debris.

<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/12/2014
<b>Inspection no.:</b> A14-135-19	<b>Address:</b> 702 Main St.	<b>Sewer:</b> D8EA	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8EA	<b>Total length:</b> 2.13 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8EB	<b>Page:</b> 57
<b>Profile:</b> Circle / 250 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Cleaned

1 : 550

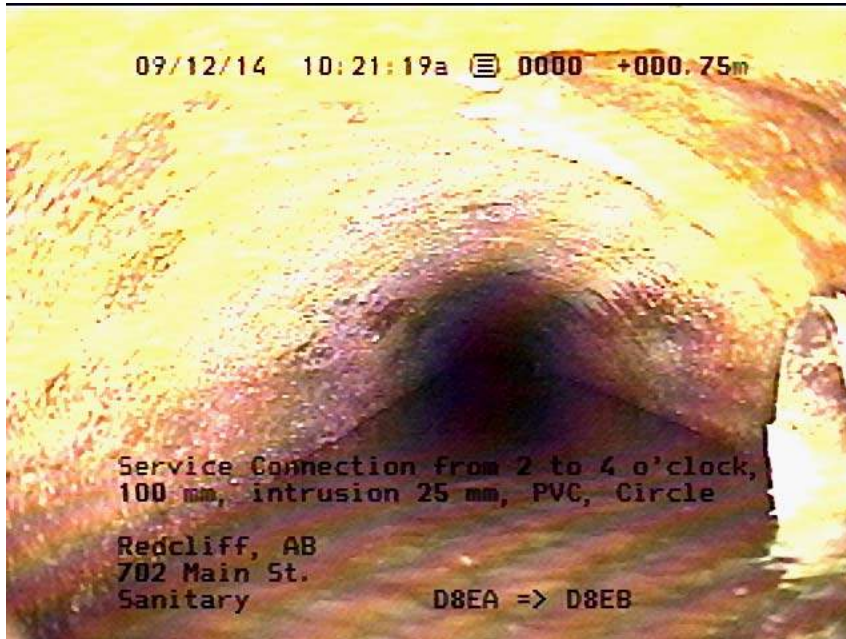
## sewer inspection

	Start	End	Code	Description	DC Video	Photo
	0.75	0.75	ST	Start of Survey , 250 mm, TP Clay Tile Pipe, Circle	00:00:00	
	0.75	0.75	II	WL-25%	00:00:00	
	0.75	0.75	CN	Service Connection from 2 to 4 o'clock, 100 mm, intrusion 25 mm, PVC, Circle	00:00:00	1
	2.13	2.13	BM	Debris Moderate - < 25% flow area restriction . Unable to pass.	00:00:00	2
	2.13	2.13	FH	End of Survey	00:00:00	



<b>Client:</b> ISL Engineering	<b>City:</b> Redcliff, AB	<b>Project:</b> A14-135	<b>Date:</b> 9/12/2014
<b>Inspection no.:</b> A14-135-19	<b>Address:</b> 702 Main St.	<b>Sewer:</b> D8EA	<b>Video Tape no.:</b> 1
<b>Contract no.:</b>	<b>Reason of insp.:</b> Assessment	<b>Start Manhole:</b> D8EA	<b>Total length:</b> 2.13 m
<b>Operator:</b> Kevin McMillan	<b>Direction:</b> Downstream	<b>End Manhole:</b> D8EB	<b>Page:</b> 58
<b>Profile:</b> Circle / 250 mm	<b>Sewer type:</b> Sanitary	<b>Material:</b> TP Clay Tile Pipe	<b>Condition:</b> Cleaned

## sewer inspection



**Photo** : 1  
**Distance** : 0.75 m  
**Video** : 00:00:00  
**DC** :  
**Code** : CN  
Service Connection from  
2 to 4 o'clock, 100 mm,  
intrusion 25 mm, PVC,  
Circle

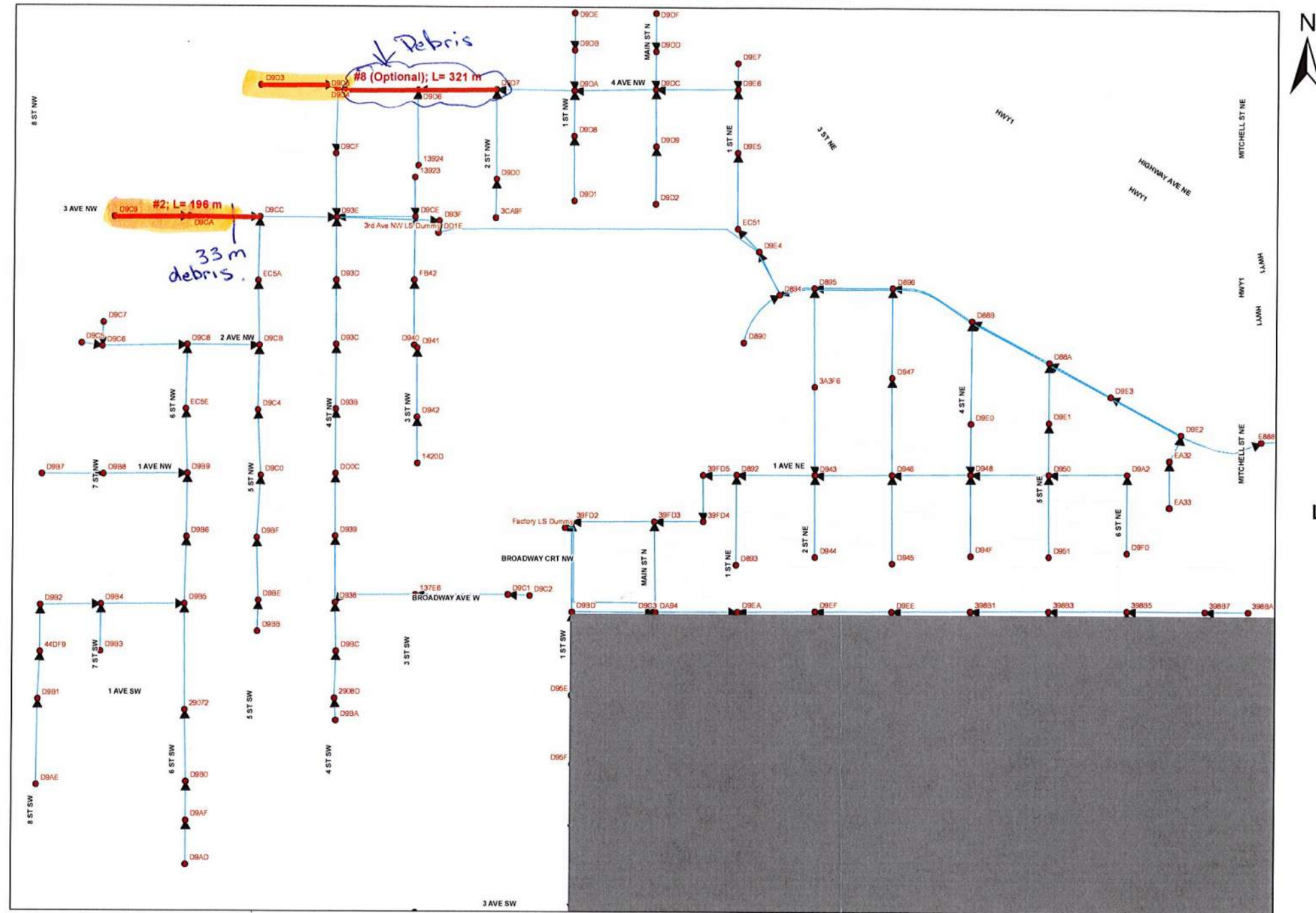


**Photo** : 2  
**Distance** : 2.13 m  
**Video** : 00:00:00  
**DC** :  
**Code** : BM  
Debris Moderate - < 25%  
flow area restriction .  
Unable to pass.



## **Appendix II Project Maps**

# TOWN OF REDCLIFF: PROPOSED CCTV INSPECTION LOCATIONS - NORTHWEST TRUNK



## Legend



- Sewers To Be CCTV'ed
- Sanitary Manhole
- ▶ Sanitary Pipe

Length of Sewer To Be CCTV'ed = 518m

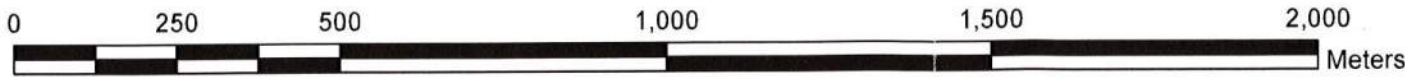
NW SAN Sewer Length = 9,640m



Map showing a street grid with various streets labeled (e.g., 1st St SE, 2nd St SE, 3rd St SE, 4th St SE, 5th St SE, 6th St SE, 7th St SE, 8th St SE, 9th St SE, 1st St SW, 2nd St SW, 3rd St SW, 4th St SW, 5th St SW, 6th St SW, 7th St SW, 8th St SW, 9th St SW). The map includes numerous street names and numbers, and various markers (e.g., D98D, D98C, D98A, D98E, D98F, D98G, D98H, D98I, D98J, D98K, D98L, D98M, D98N, D98O, D98P, D98Q, D98R, D98S, D98T, D98U, D98V, D98W, D98X, D98Y, D98Z, D98AA, D98AB, D98AC, D98AD, D98AE, D98AF, D98AG, D98AH, D98AI, D98AJ, D98AK, D98AL, D98AM, D98AN, D98AO, D98AP, D98AQ, D98AR, D98AS, D98AT, D98AU, D98AV, D98AW, D98AX, D98AY, D98AZ, D98BA, D98BB, D98BC, D98BD, D98BE, D98BF, D98BG, D98BH, D98BI, D98BJ, D98BK, D98BL, D98BM, D98BN, D98BO, D98BP, D98BQ, D98BR, D98BS, D98BT, D98BU, D98BV, D98BW, D98BX, D98BY, D98BZ, D98CA, D98CB, D98CC, D98CD, D98CE, D98CF, D98CG, D98CH, D98CI, D98CJ, D98CK, D98CL, D98CM, D98CN, D98CO, D98CP, D98CQ, D98CR, D98CS, D98CT, D98CU, D98CV, D98CW, D98CX, D98CY, D98CZ, D98DA, D98DB, D98DC, D98DD, D98DE, D98DF, D98DG, D98DH, D98DI, D98DJ, D98DK, D98DL, D98DM, D98DN, D98DO, D98DP, D98DQ, D98DR, D98DS, D98DT, D98DU, D98DV, D98DW, D98DX, D98DY, D98DZ, D98EA, D98EB, D98EC, D98ED, D98EE, D98EF, D98EG, D98EH, D98EI, D98EJ, D98EK, D98EL, D98EM, D98EN, D98EO, D98EP, D98EQ, D98ER, D98ES, D98ET, D98EU, D98EV, D98EW, D98EX, D98EY, D98EZ, D98FA, D98FB, D98FC, D98FD, D98FE, D98FF, D98FG, D98FH, D98FI, D98FJ, D98FK, D98FL, D98FM, D98FN, D98FO, D98FP, D98FQ, D98FR, D98FS, D98FT, D98FU, D98FV, D98FW, D98FX, D98FY, D98FZ, D98GA, D98GB, D98GC, D98GD, D98GE, D98GF, D98GG, D98GH, D98GI, D98GJ, D98GK, D98GL, D98GM, D98GN, D98GO, D98GP, D98GQ, D98GR, D98GS, D98GT, D98GU, D98GV, D98GW, D98GX, D98GY, D98GZ, D98HA, D98HB, D98HC, D98HD, D98HE, D98HF, D98HG, D98HH, D98HI, D98HJ, D98HK, D98HL, D98HM, D98HN, D98HO, D98HP, D98HQ, D98HR, D98HS, D98HT, D98HU, D98HV, D98HW, D98HX, D98HY, D98HZ, D98IA, D98IB, D98IC, D98ID, D98IE, D98IF, D98IG, D98IH, D98II, D98IJ, D98IK, D98IL, D98IM, D98IN, D98IO, D98IP, D98IQ, D98IR, D98IS, D98IT, D98IU, D98IV, D98IW, D98IX, D98IY, D98IZ, D98JA, D98JB, D98JC, D98JD, D98JE, D98JF, D98JG, D98JH, D98JI, D98JJ, D98JK, D98JL, D98JM, D98JN, D98JO, D98JP, D98JQ, D98JR, D98JS, D98JT, D98JU, D98JV, D98JW, D98JX, D98JY, D98JZ, D98KA, D98KB, D98KC, D98KD, D98KE, D98KF, D98KG, D98KH, D98KI, D98KJ, D98KK, D98KL, D98KM, D98KN, D98KO, D98KP, D98KQ, D98KR, D98KS, D98KT, D98KU, D98KV, D98KW, D98KX, D98KY, D98KZ, D98LA, D98LB, D98LC, D98LD, D98LE, D98LF, D98LG, D98LH, D98LI, D98LJ, D98LK, D98LL, D98LM, D98LN, D98LO, D98LP, D98LQ, D98LR, D98LS, D98LT, D98LU, D98LV, D98LW, D98LX, D98LY, D98LZ, D98MA, D98MB, D98MC, D98MD, D98ME, D98MF, D98MG, D98MH, D98MI, D98MJ, D98MK, D98ML, D98MM, D98MN, D98MO, D98MP, D98MQ, D98MR, D98MS, D98MT, D98MU, D98MV, D98MW, D98MX, D98MY, D98MZ, D98NA, D98NB, D98NC, D98ND, D98NE, D98NF, D98NG, D98NH, D98NI, D98NJ, D98NK, D98NL, D98NM, D98NN, D98NO, D98NP, D98NQ, D98NR, D98NS, D98NT, D98NU, D98NV, D98NW, D98NX, D98NY, D98NZ, D98OA, D98OB, D98OC, D98OD, D98OE, D98OF, D98OG, D98OH, D98OI, D98OJ, D98OK, D98OL, D98OM, D98ON, D98OO, D98OP, D98OQ, D98OR, D98OS, D98OT, D98OU, D98OV, D98OW, D98OX, D98OY, D98OZ, D98PA, D98PB, D98PC, D98PD, D98PE, D98PF, D98PG, D98PH, D98PI, D98PJ, D98PK, D98PL, D98PM, D98PN, D98PO, D98PP, D98PQ, D98PR, D98PS, D98PT, D98PU, D98PV, D98PW, D98PX, D98PY, D98PZ, D98QA, D98QB, D98QC, D98QD, D98QE, D98QF, D98QG, D98QH, D98QI, D98QJ, D98QK, D98QL, D98QM, D98QN, D98QO, D98QP, D98QQ, D98QR, D98QS, D98QT, D98QU, D98QV, D98QW, D98QX, D98QY, D98QZ, D98RA, D98RB, D98RC, D98RD, D98RE, D98RF, D98RG, D98RH, D98RI, D98RJ, D98RK, D98RL, D98RM, D98RN, D98RO, D98RP, D98RQ, D98RR, D98RS, D98RT, D98RU, D98RV, D98RW, D98RX, D98RY, D98RZ, D98SA, D98SB, D98SC, D98SD, D98SE, D98SF, D98SG, D98SH, D98SI, D98SJ, D98SK, D98SL, D98SM, D98SN, D98SO, D98SP, D98SQ, D98SR, D98SS, D98ST, D98SU, D98SV, D98SW, D98SX, D98SY, D98SZ, D98TA, D98TB, D98TC, D98TD, D98TE, D98TF, D98TG, D98TH, D98TI, D98TJ, D98TK, D98TL, D98TM, D98TN, D98TO, D98TP, D98TQ, D98TR, D98TS, D98TT, D98TU, D98TV, D98TW, D98TX, D98TY, D98TZ, D98UA, D98UB, D98UC, D98UD, D98UE, D98UF, D98UG, D98UH, D98UI, D98UJ, D98UK, D98UL, D98UM, D98UN, D98UO, D98UP, D98UQ, D98UR, D98US, D98UT, D98UU, D98UV, D98UW, D98UX, D98UY, D98UZ, D98VA, D98VB, D98VC, D98VD, D98VE, D98VF, D98VG, D98VH, D98VI, D98VJ, D98VK, D98VL, D98VM, D98VN, D98VO, D98VP, D98VQ, D98VR, D98VS, D98VT, D98VU, D98VV, D98VW, D98VX, D98VY, D98VZ, D98WA, D98WB, D98WC, D98WD, D98WE, D98WF, D98WG, D98WH, D98WI, D98WJ, D98WK, D98WL, D98WM, D98WN, D98WO, D98WP, D98WQ, D98WR, D98WS, D98WT, D98WU, D98WV, D98WW, D98WX, D98WY, D98WZ, D98XA, D98XB, D98XC, D98XD, D98XE, D98XF, D98XG, D98XH, D98XI, D98XJ, D98XK, D98XL, D98XM, D98XN, D98XO, D98XP, D98XQ, D98XR, D98XS, D98XT, D98XU, D98XV, D98XW, D98XX, D98XY, D98XZ, D98YA, D98YB, D98YC, D98YD, D98YE, D98YF, D98YG, D98YH, D98YI, D98YJ, D98YK, D98YL, D98YM, D98YN, D98YO, D98YP, D98YQ, D98YR, D98YS, D98YT, D98YU, D98YV, D98YW, D98YX, D98YY, D98YZ, D98ZA, D98ZB, D98ZC, D98ZD, D98ZE, D98ZF, D98ZG, D98ZH, D98ZI, D98ZJ, D98ZK, D98ZL, D98ZM, D98ZN, D98ZO, D98ZP, D98ZQ, D98ZR, D98ZS, D98ZT, D98ZU, D98ZV, D98ZW, D98ZX, D98ZY, D98ZZ). The map also includes a river to the west and a highway to the east.

 Sewers To Be CCTV'ed  
 Sanitary Manhole  
 Sanitary Pipe

**DT SAN Sewer Length = 24,210m  
(excluding trunk east of MH DA0E)**



## **Appendix III Project Photos**



**Manhole: D969**

**GPS: 50.081844 -110.799436**



Manhole was plugged with gravel all along the bottom.  
Service condition looked fine.

**Manhole: D9CA**

**GPS: 50.081791 -110.798002**



Manhole lower barrel joint leaking.  
Service condition looked fine.

**Manhole: D9CC**

**GPS: 50.081844 -110.799436**



Lots of flow from South. Manhole condition is OK.

**Manhole: D95B**

**GPS: 50.072648 -110.793780**



Unable to enter with camera. Manhole has a lot of debris.

**Manhole: 3st/3 Ave**

**GPS: 50.073454 -110.793709**



Unable to enter manhole has debris.  
Service condition looked fine.

**Manhole: D95D**

**GPS: 50.071126 -110.790866**



Manhole OK. Many pipes entering manhole.



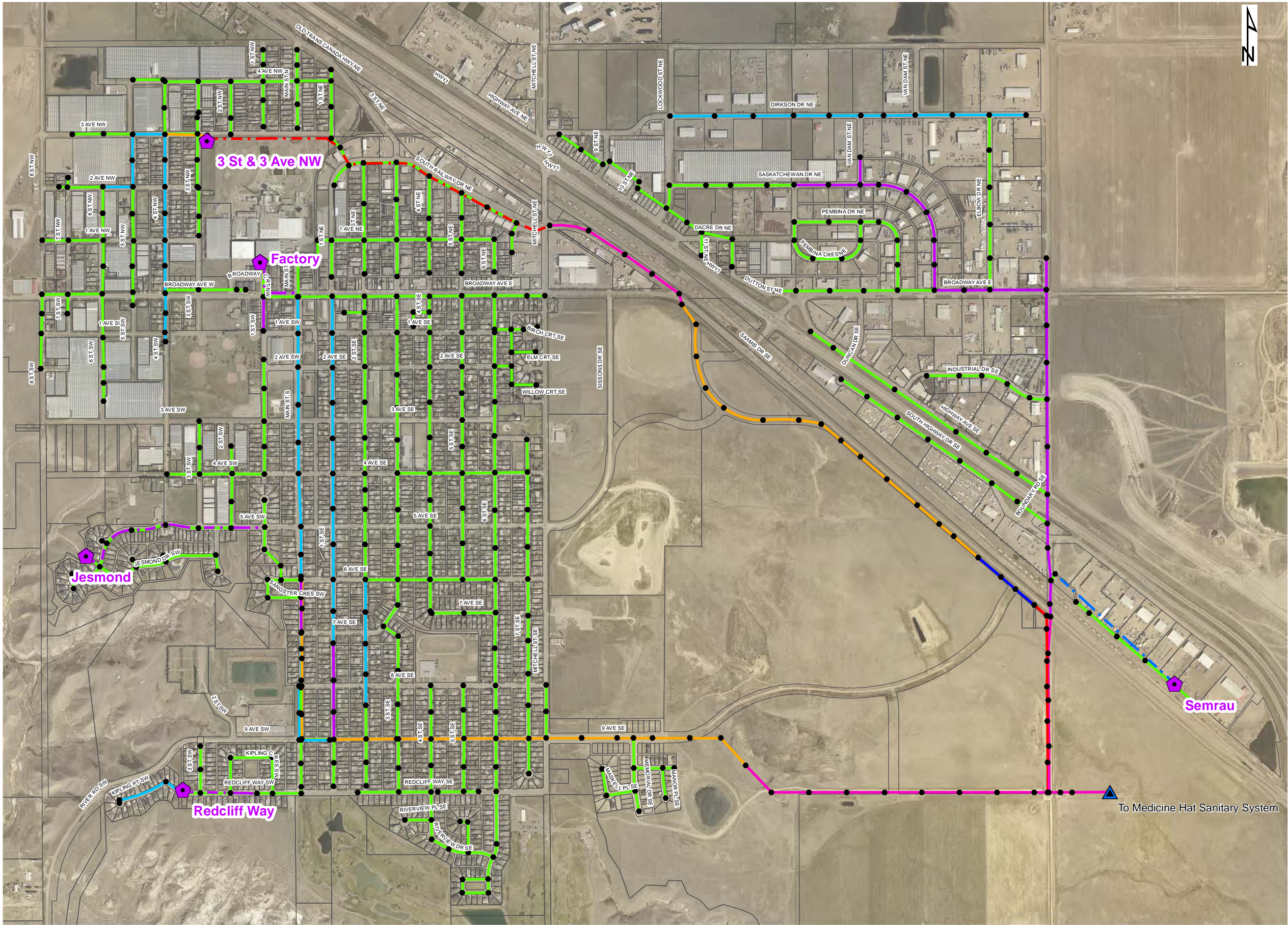


FIGURE 2.1

# Legend

Lift Station

## Sanitary Forcemain

75mm

150mm

250mm

## Sanitary Gravity Sewer

200mm

250mm

300mm

375mm

450mm

525mm

750mm

1:12,500



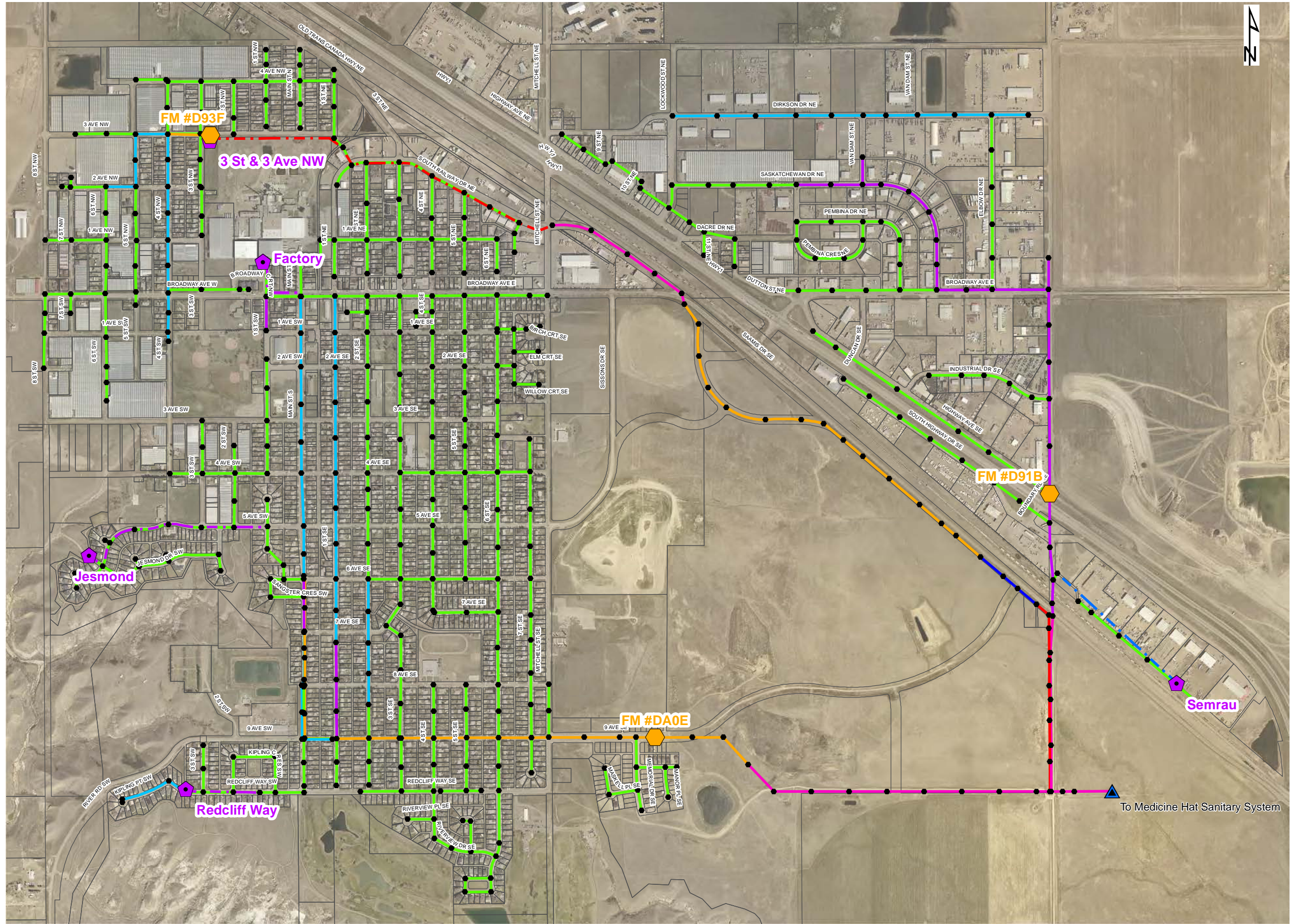
TOWN OF REDCLIFF  
SANITARY I-I STUDY

SANITARY SEWER SYSTEM





FIGURE 3.1



## Legend

Flow Monitor

Lift Station

### Sanitary Forcemain

75mm

150mm

250mm

### Sanitary Gravity Sewer

200mm

250mm

300mm

375mm

450mm

525mm

750mm

1:12,500

0 50 100 200 300 400 Meters



TOWN OF REDCLIFF  
SANITARY I-I STUDY

SANITARY SEWER SYSTEM  
FLOW MONITORING LOCATIONS





FIGURE 4.1

# Legend

## Dry Weather Flow Generation Rates

- 200 L/p/d (Residential)
- 5.00 cu.m/ha/d (Commercial)
- 6.00 cu.m/ha/d (Commercial)
- 1.00 cu.m/ha/d (Industrial)
- 4.72 cu.m/ha/d (Horticultural)
- 17.28 cu.m/ha/d (Horticultural)

Sanitary Trunk

Lift Station

1:13,000



TOWN OF REDCLIFF  
SANITARY I-I STUDY

HYDRODYNAMIC MODEL  
DRY WEATHER FLOW CALIBRATION  
GENERATION RATES

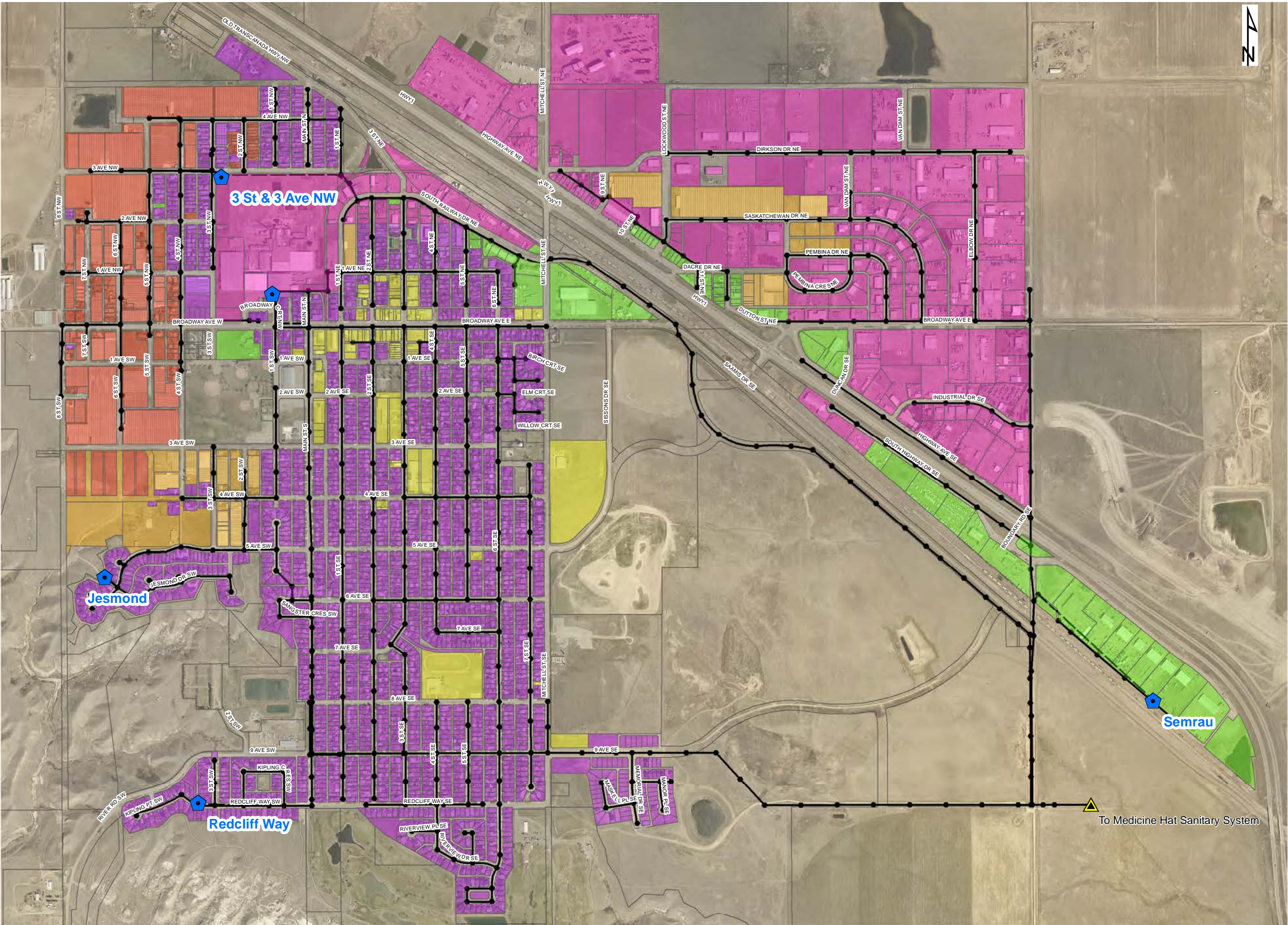
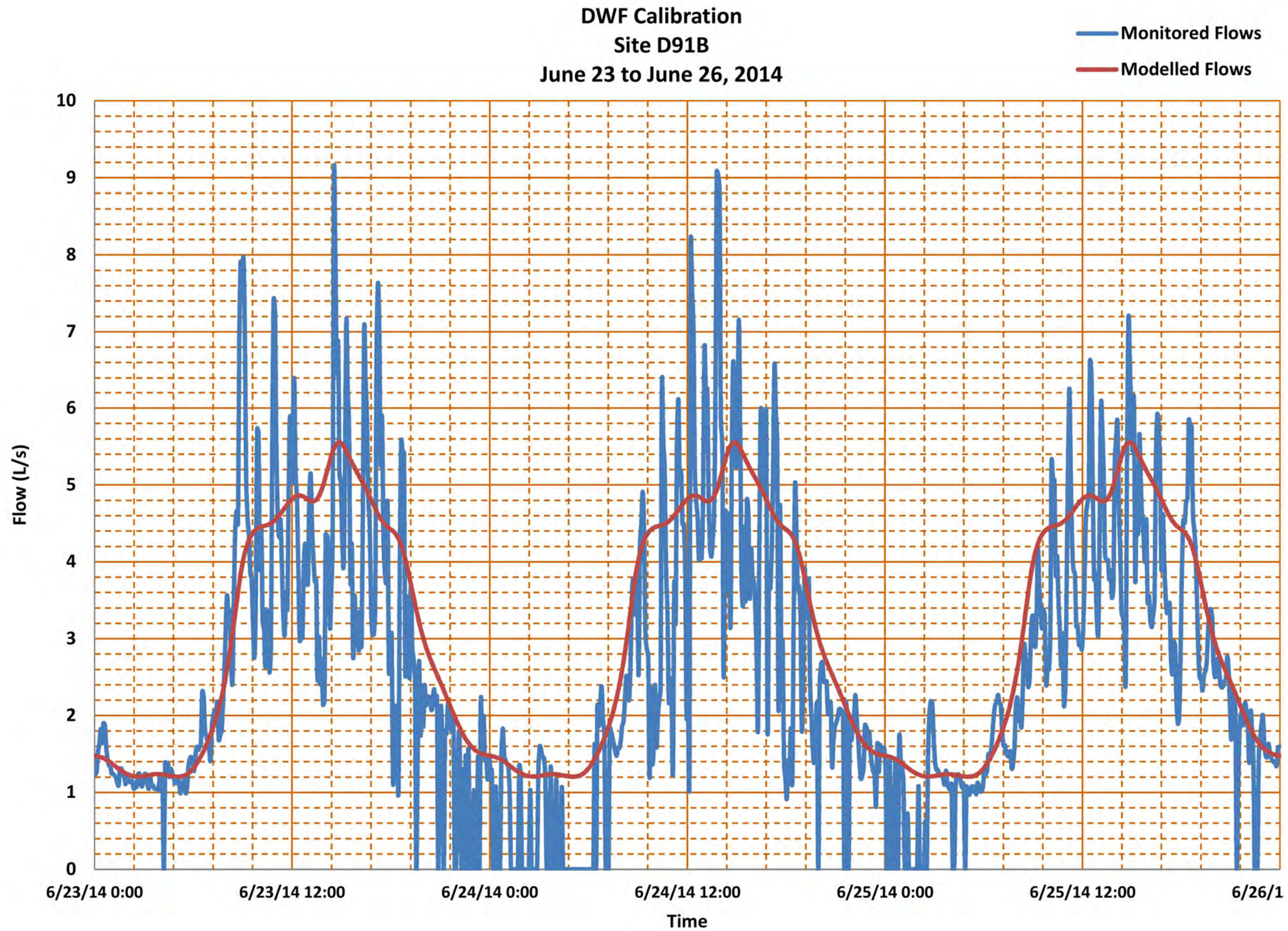




FIGURE 4.2

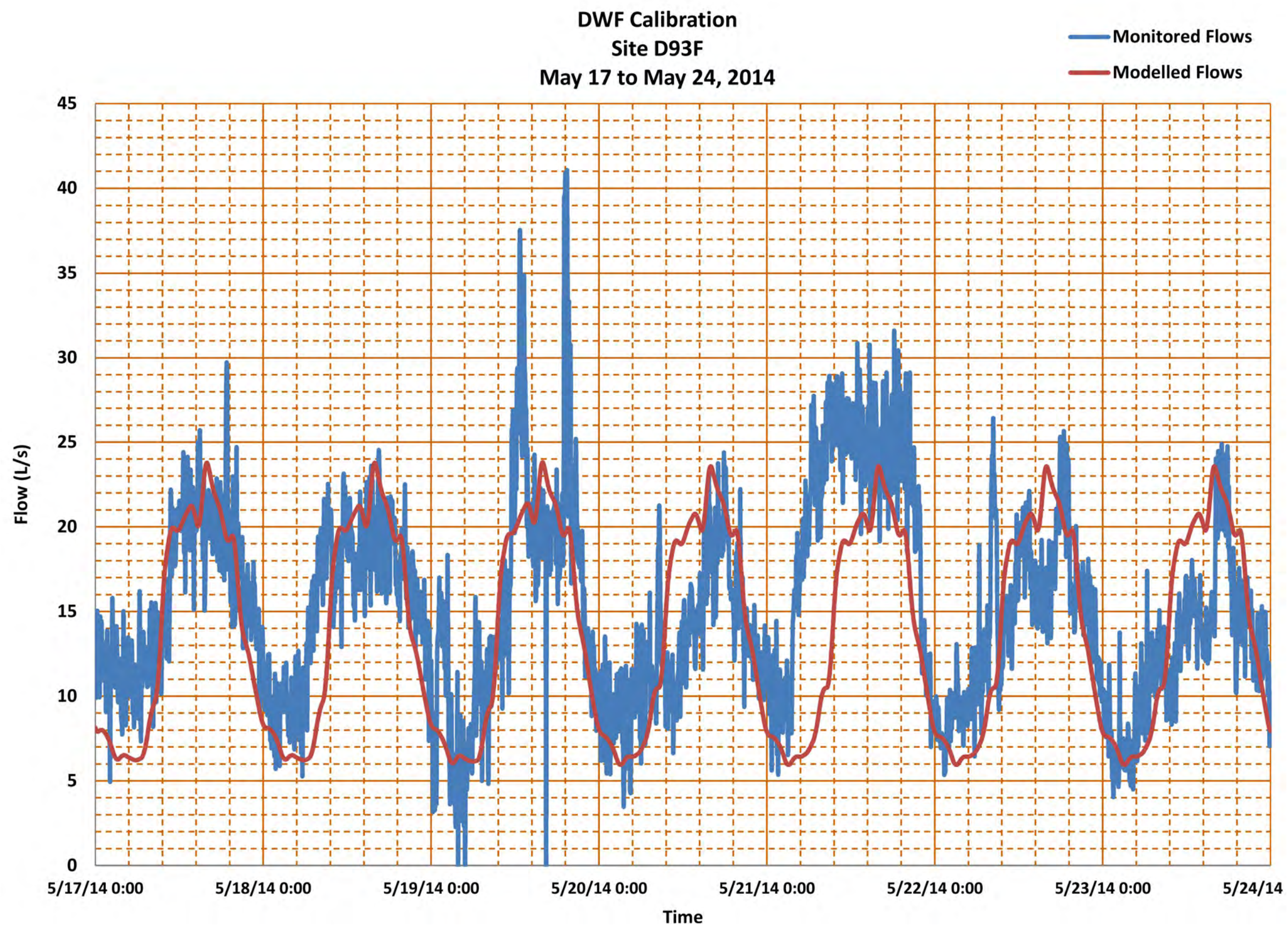


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**DRY WEATHER FLOW CALIBRATION**  
**MONITORED VS. MODELLED FLOWS**  
**SITE #D91B**



FIGURE 4.3

RAFAL JADZINSKI Apr. 7, 15 11:17:14 AM N:\26000\26031\_REDCLIFF\_SANITARY\_I\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\CALIBRATION GRAPHS\26031\_DWF\_CALIBRATION GRAPHS.DWG

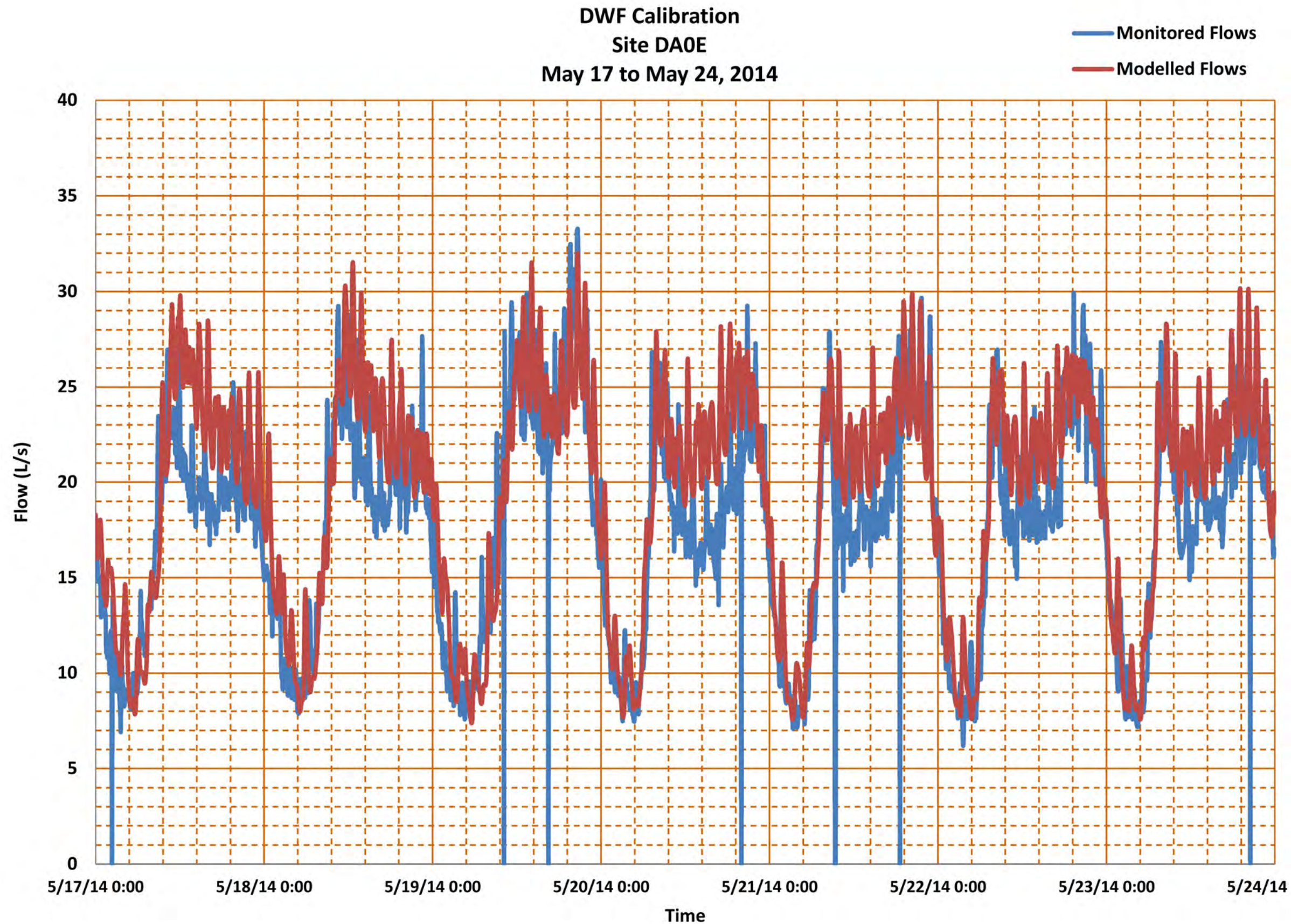


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**DRY WEATHER FLOW CALIBRATION**  
**MONITORED VS. MODELLED FLOWS**  
GHD 8-11





FIGURE 4.4



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**DRY WEATHER FLOW CALIBRATION**  
**MONITORED VS. MODELLED FLOWS**  
**SITE #DA0E**



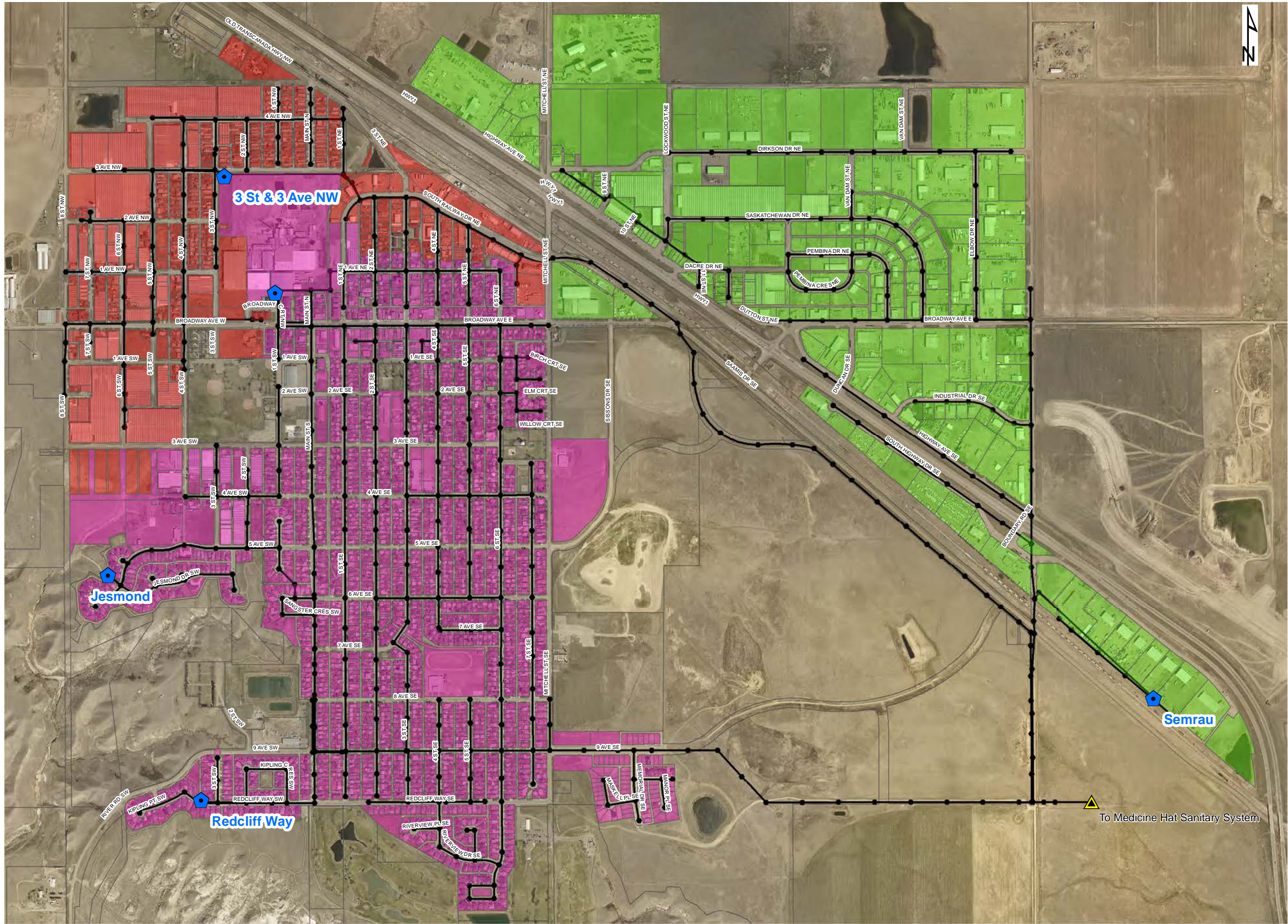
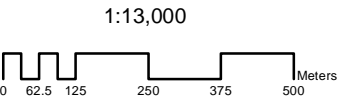


FIGURE 4.5

Legend

Percent Impervious Areas

- 4.0% (Site #D93F)
- 1.8% (Site #DA0E)
- 0.3% (Site #D91B)
- 0.3% (Non-FM'ed Sites)
- Sanitary Trunk
- Lift Station



TOWN OF REDCLIFF  
SANITARY I-I STUDY  
HYDRODYNAMIC MODEL  
WET WEATHER FLOW CALIBRATION  
PERCENT IMPERVIOUS AREA





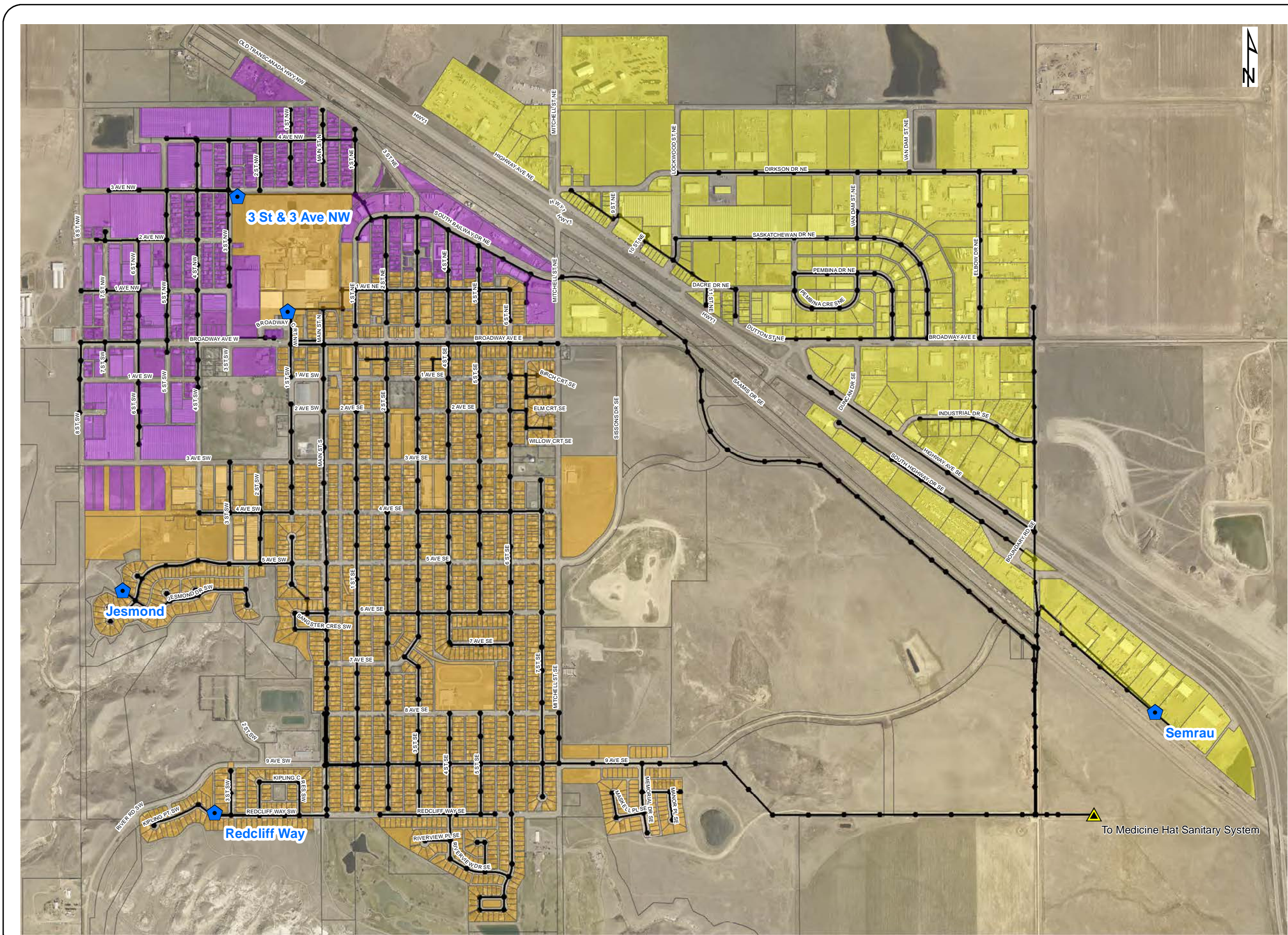


FIGURE 4.6

# Legend

## Percent Area Contributing To RDII

- 10.0% (Site #D93F)
- 10.0% (Site #DA0E)
- 1.0% (Site #D91B)
- 1.0% (Non-FM'ed Sites)
- Sanitary Trunk
- Lift Station

1:13,000

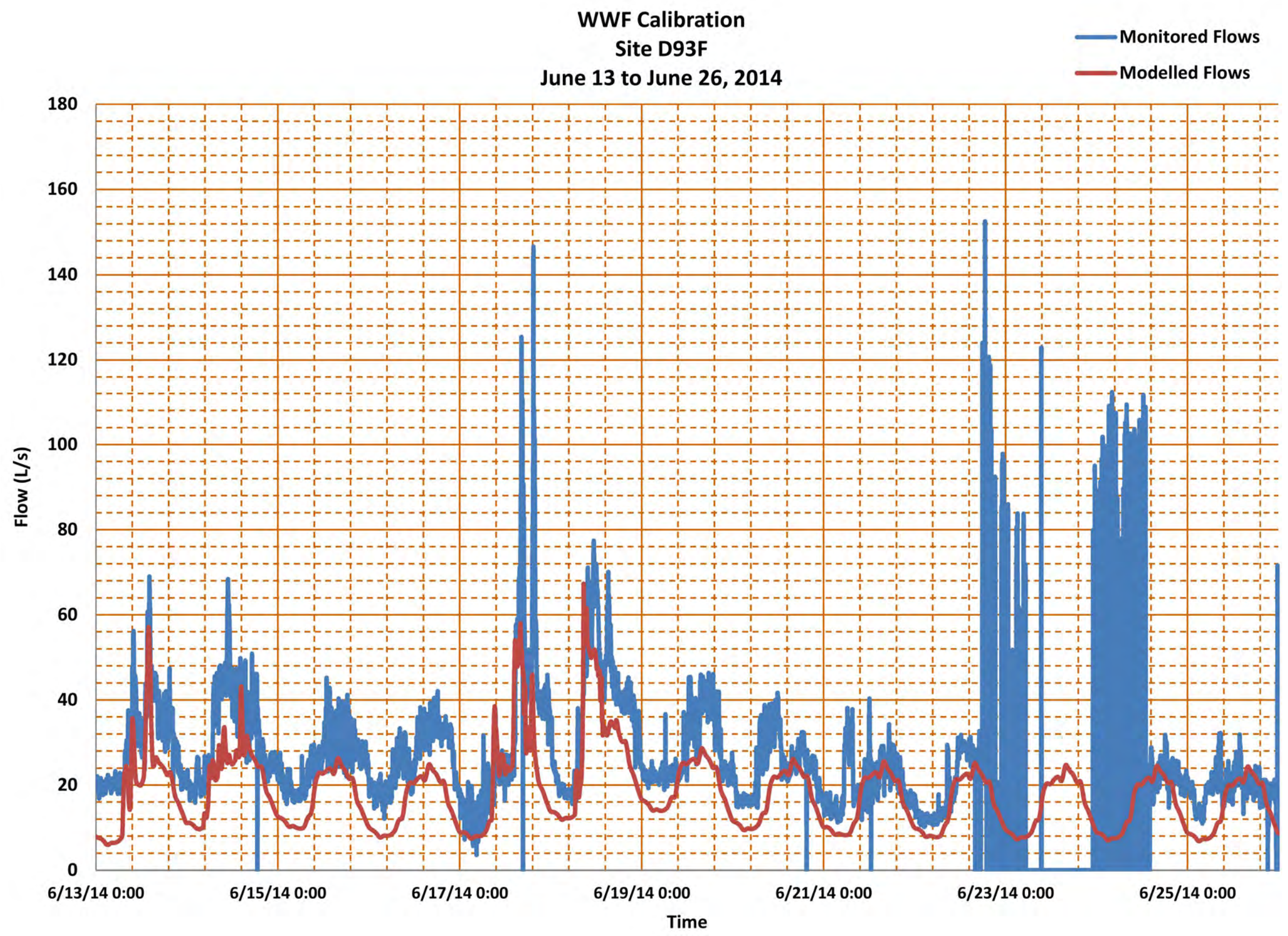


TOWN OF REDCLIFF  
SANITARY I-I STUDY  
HYDRODYNAMIC MODEL  
WET WEATHER FLOW CALIBRATION  
PERCENT AREA CONTRIBUTING TO RDII





FIGURE 4.7

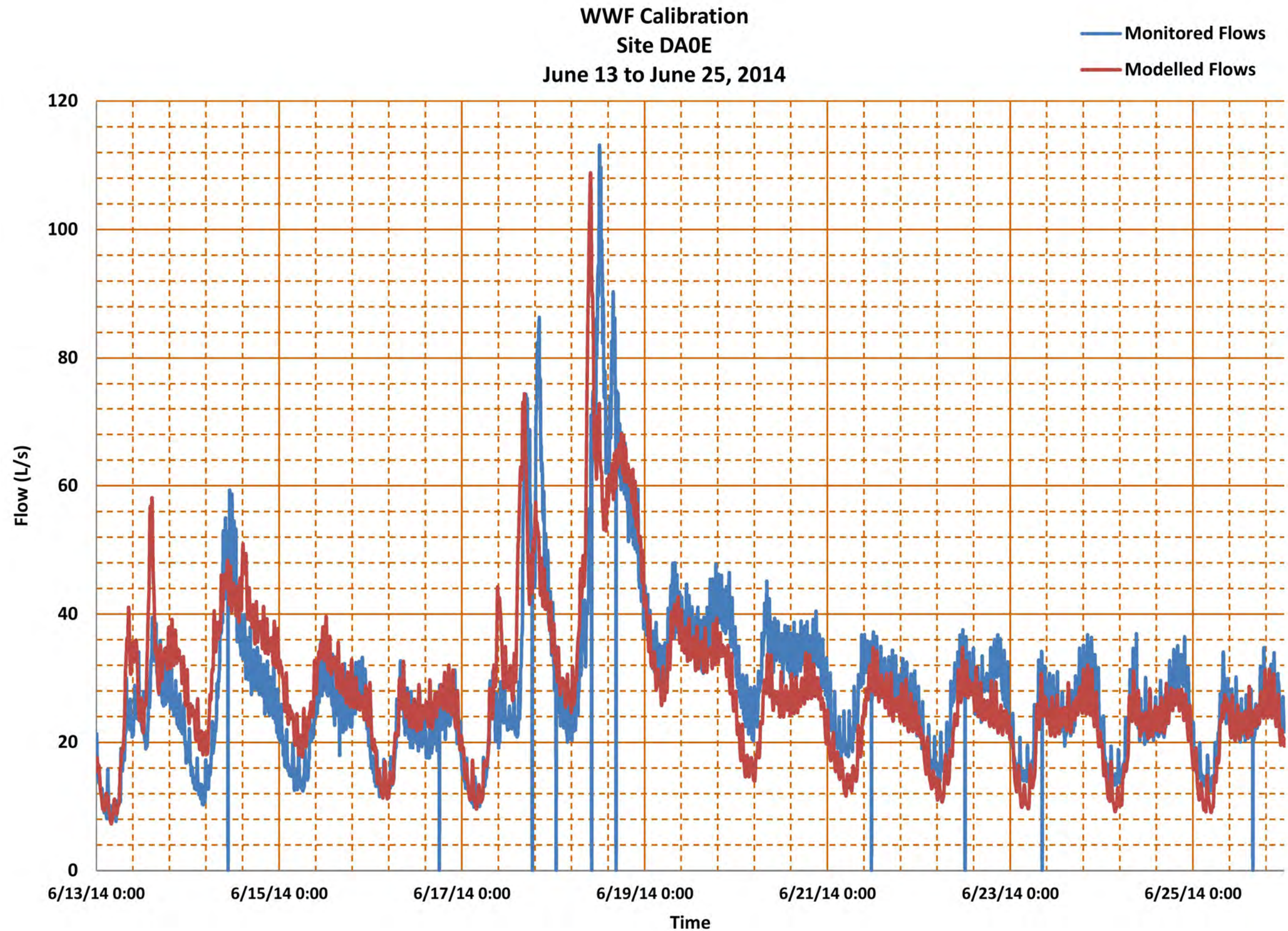


**TOWN OF REDCLIFF**  
**SANITARY II STUDY**  
**WET WEATHER FLOW CALIBRATION**  
**MONITORED VS. MODELLED FLOWS**  
GHD 8-11

RAFAŁ JADZINSKI Apr. 7, 15 12:19:52 PM N: 26000\26031\_REDCLIFF\_SANITARY\_II\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\CALIBRATION GRAPHS\26031\_WWF\_CALIBRATION GRAPHS.DWG



FIGURE 4.8



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**WET WEATHER FLOW CALIBRATION**  
**MONITORED VS. MODELLED FLOWS**  
**SITE #DA0E**



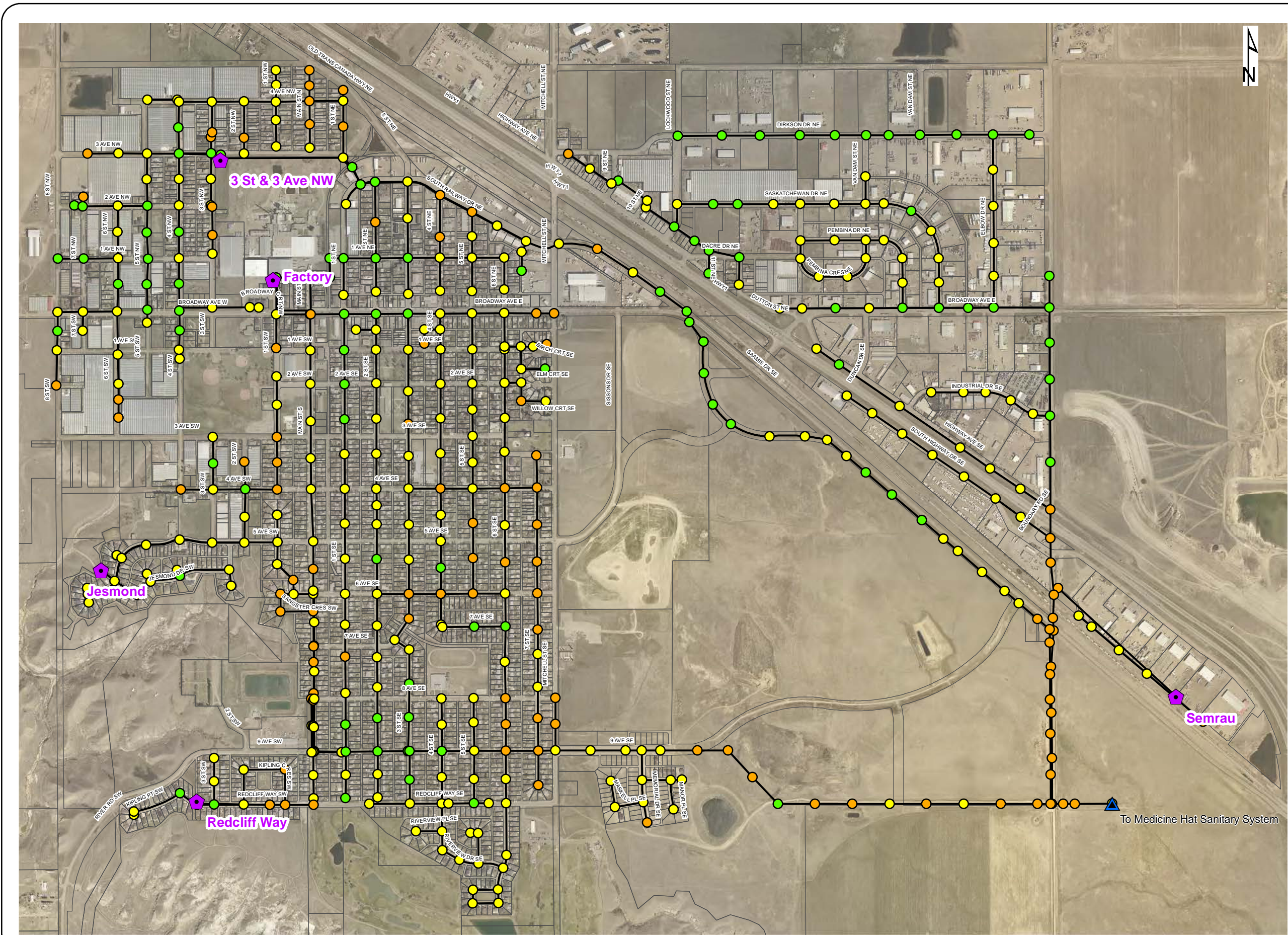
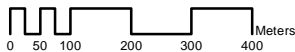


FIGURE 5.1

## Legend

- Less Than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and -0.50m
- Greater Than 0.00m
- Sanitary Trunk
- Lift Station

1:12,500



### TOWN OF REDCLIFF SANITARY I-I STUDY

PEAK HGL RELATIVE TO GROUND  
EXISTING SYSTEM PLUS  
I-I ALLOWANCE OF 0.28L/s/ha





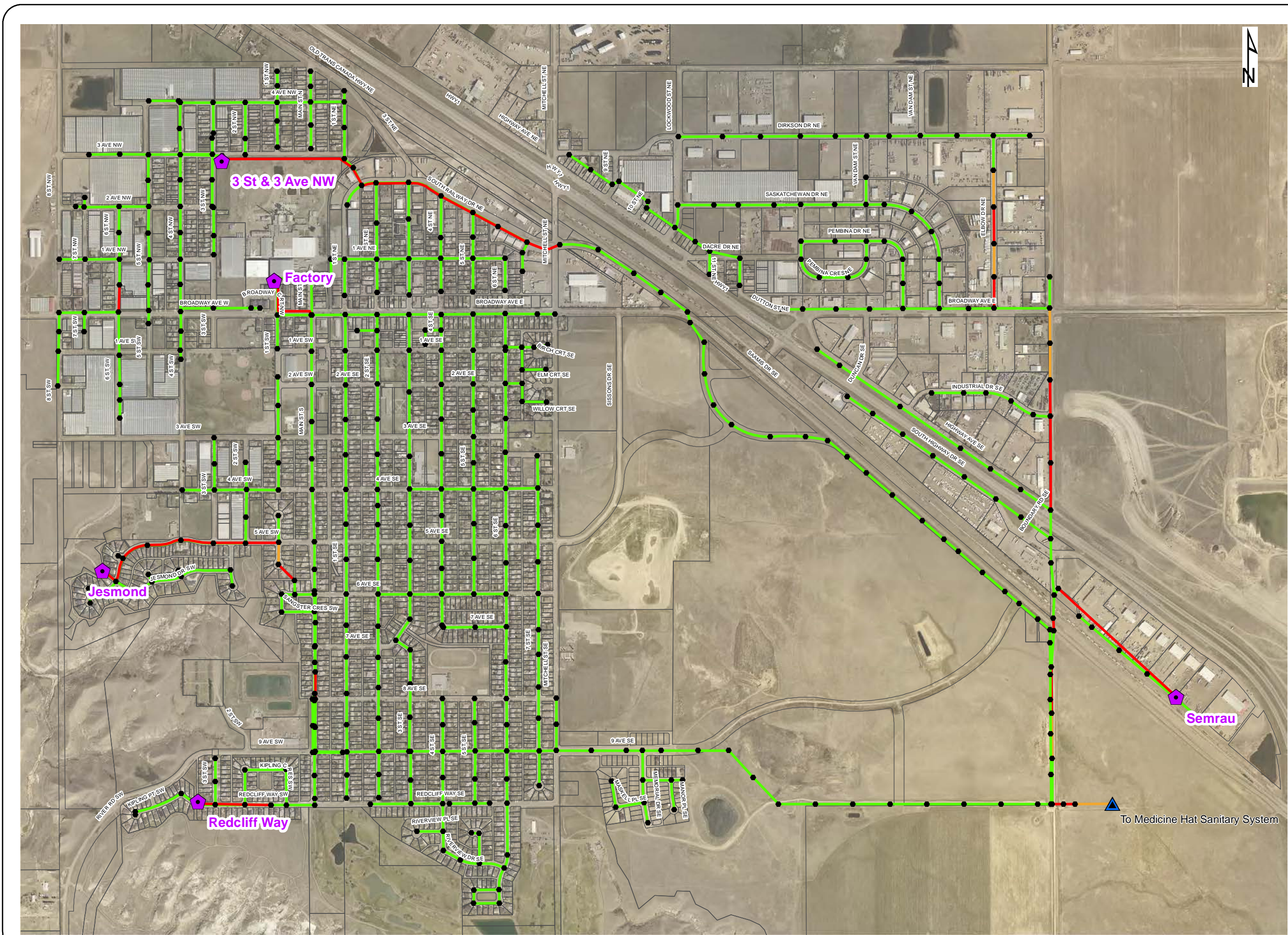


FIGURE 5.2

Legend

- Greater Than 100%
- Between 86% and 100%
- Less Than 86%
- Lift Station

1:12,500



TOWN OF REDCLIFF  
SANITARY I-I STUDY  
PEAK DISCHARGE RELATIVE TO PIPE CAPACITY  
EXISTING SYSTEM PLUS  
I-I ALLOWANCE OF 0.28L/s/ha





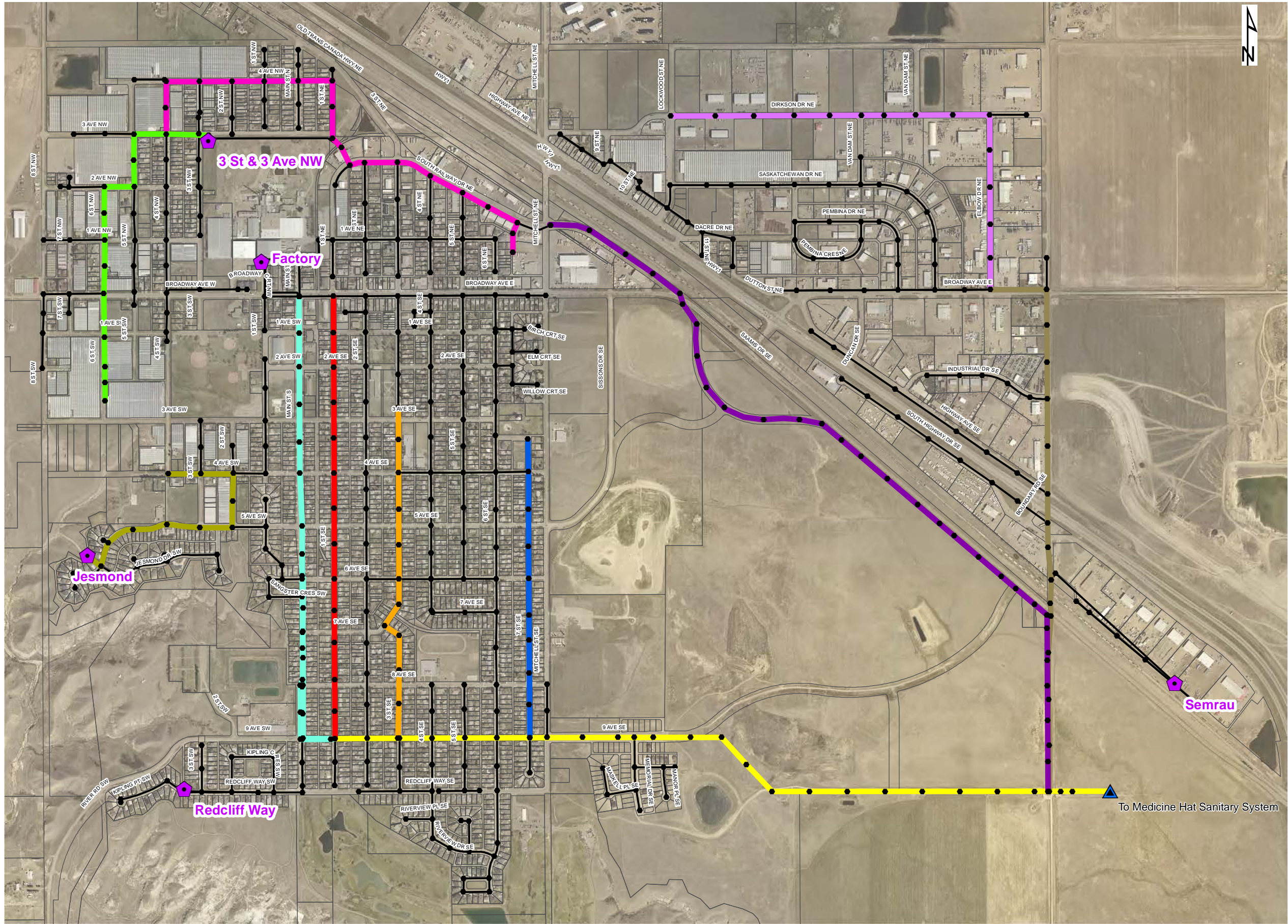
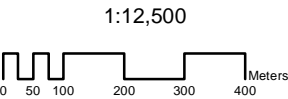


FIGURE 5.3

# Legend

## Longitudinal Profile

- #1
- #2A
- #2B
- #3
- #4
- #5
- #6
- #7
- #8
- #9
- #10
- #11
- Sanitary Trunk
- Lift Station



TOWN OF REDCLIFF  
SANITARY I-I STUDY

LONGITUDINAL PROFILES - KEY PLAN



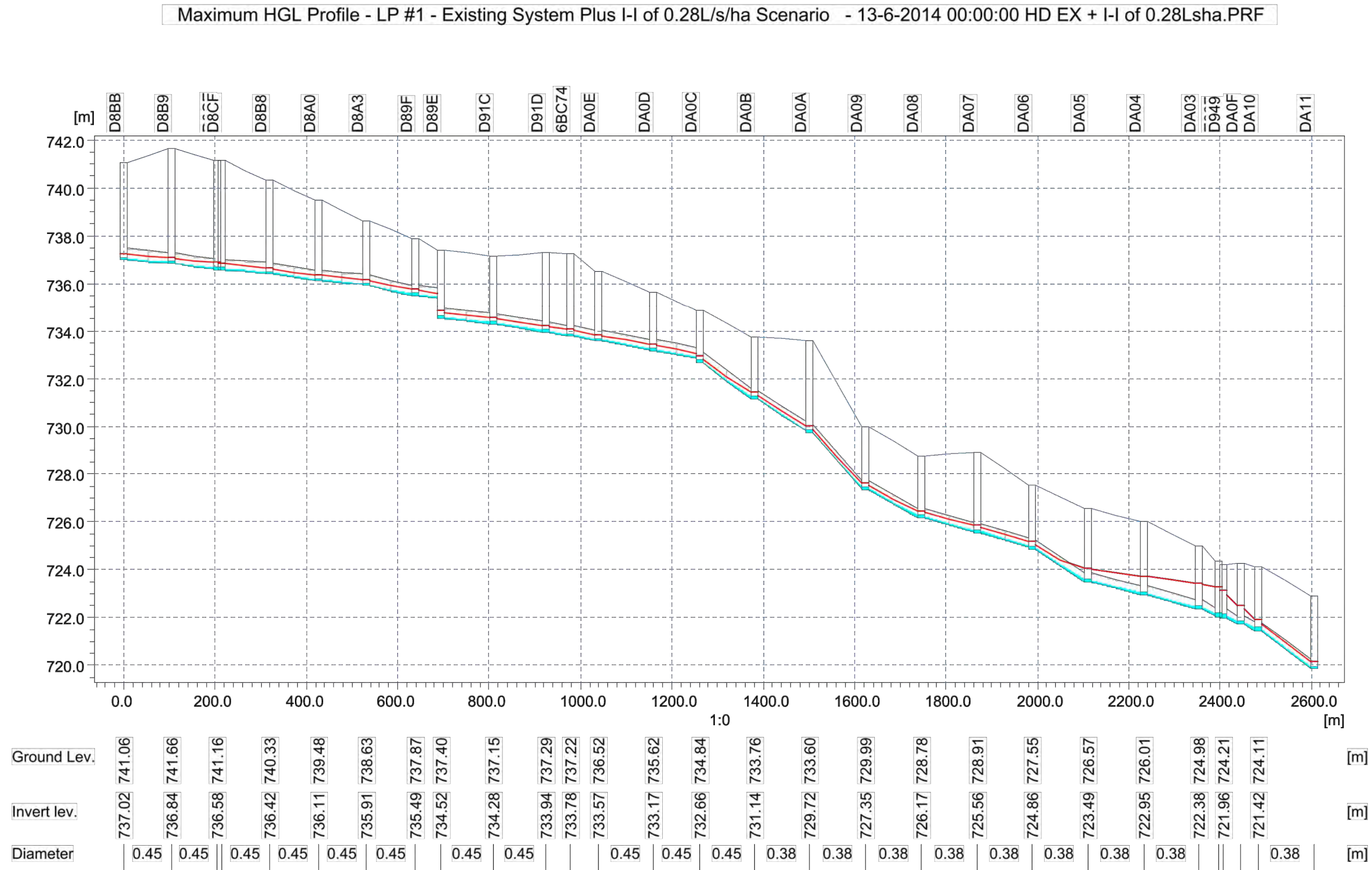
To Medicine Hat Sanitary System





FIGURE 5.4.1

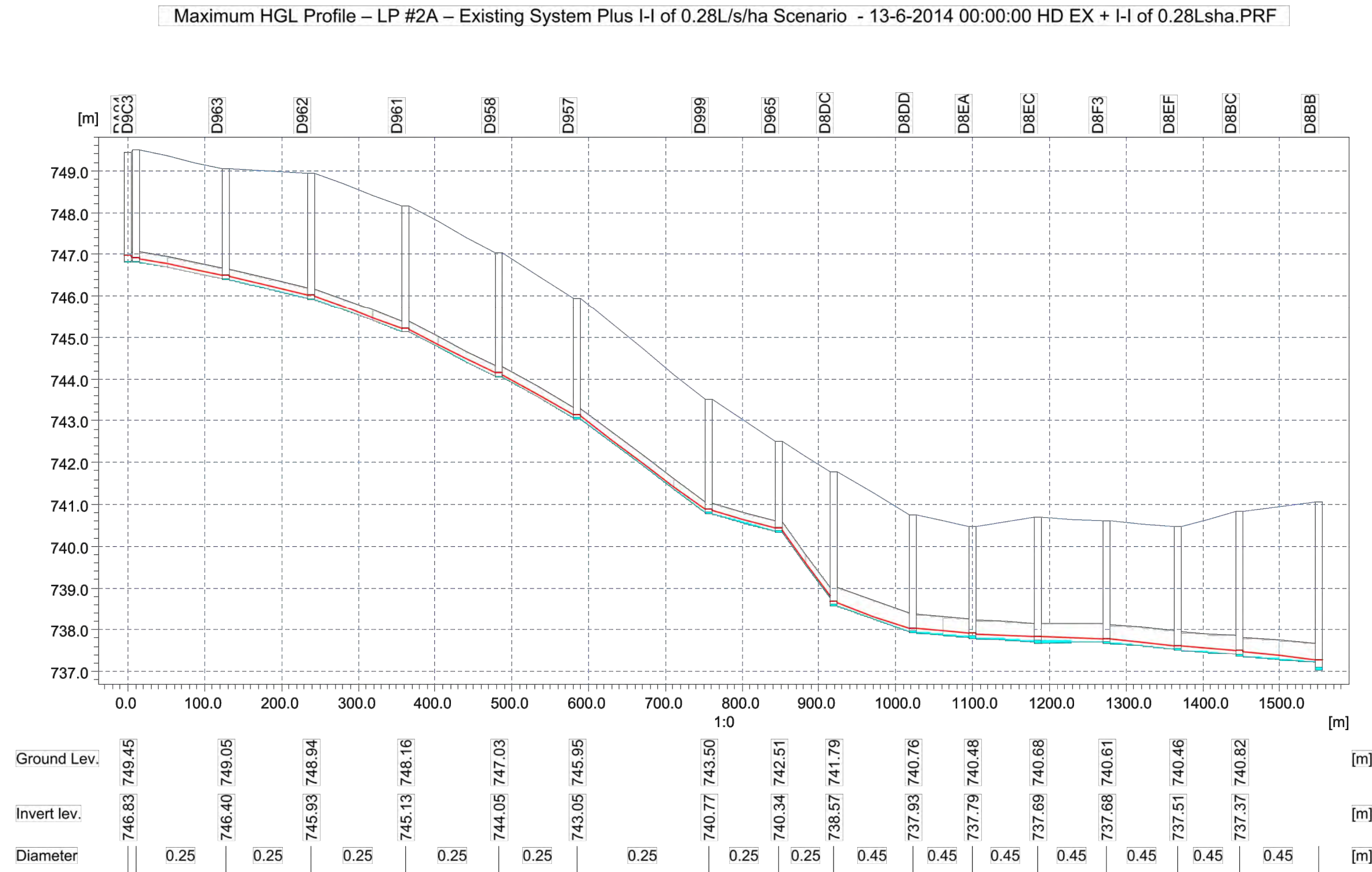
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TOWN OF REDCLIFF  
SANITARY I-I STUDY  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #1  
EXISTING TRUNK SEWER

FIGURE 5.4.2

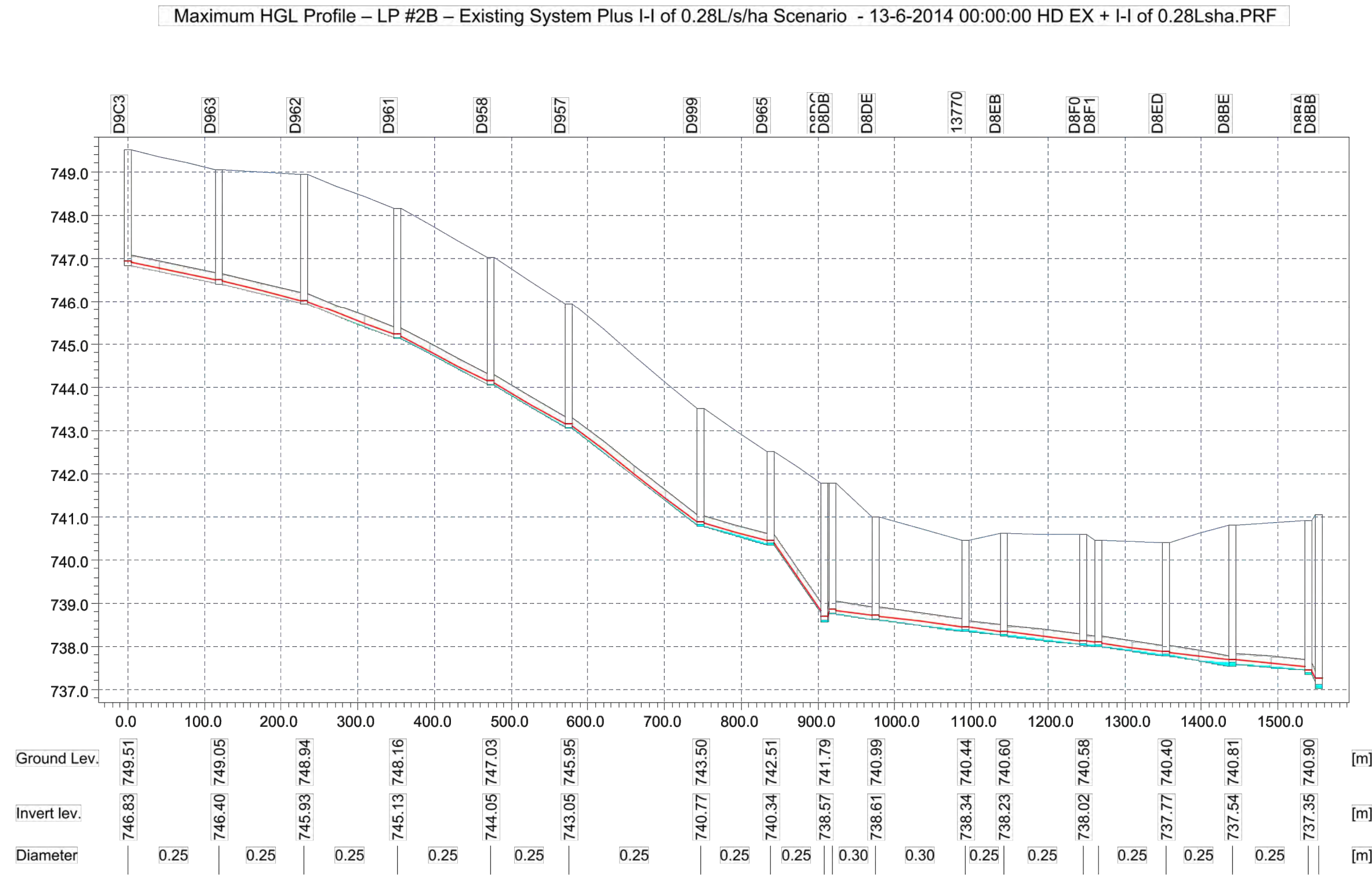
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**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #2A  
EXISTING TRUNK SEWER



FIGURE 5.4.3

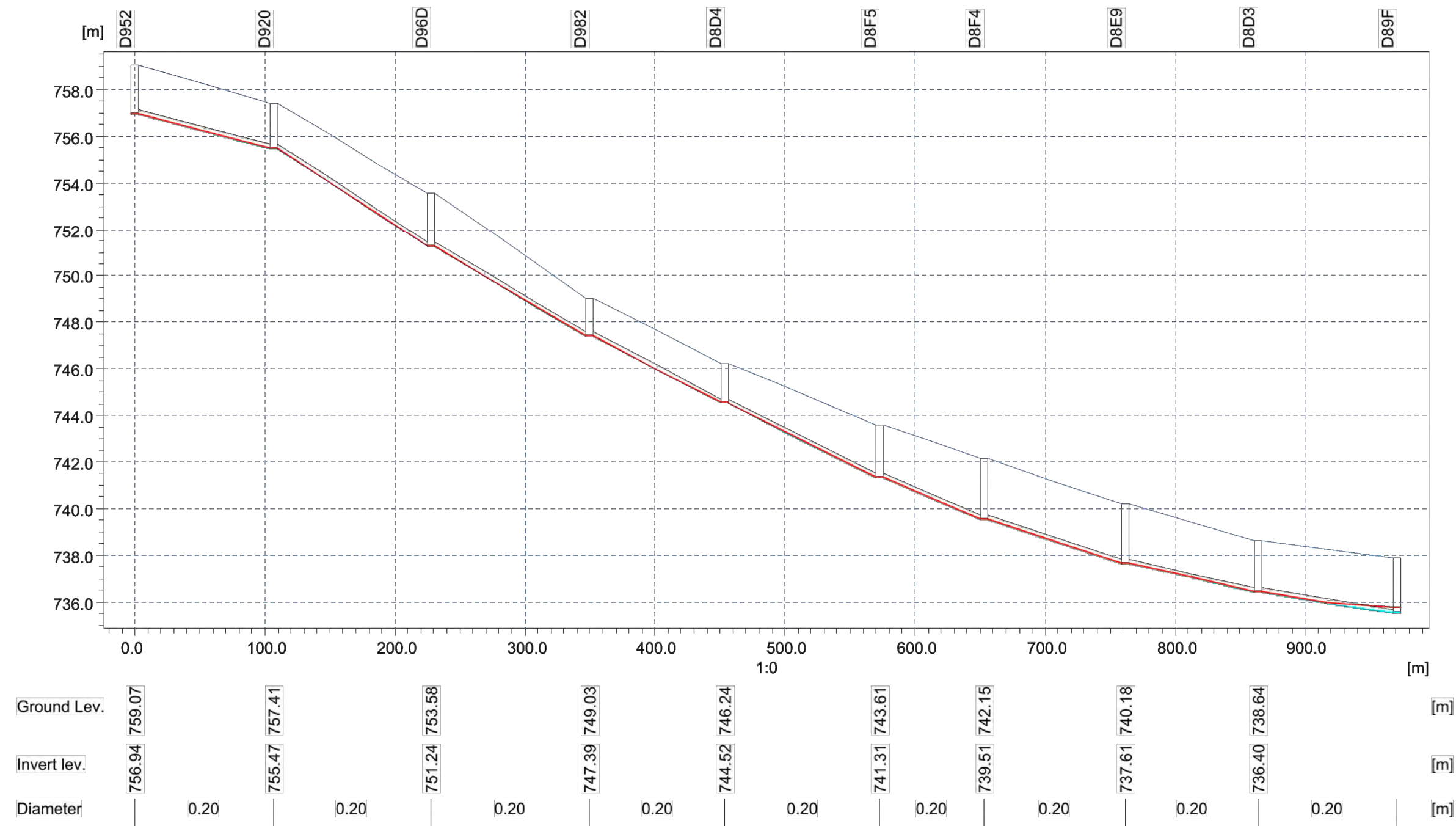


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #2B  
EXISTING TRUNK SEWER



FIGURE 5.4.4

Maximum HGL Profile – LP #3 – Existing System Plus I-I of 0.28L/s/ha Scenario - 13-6-2014 00:00:00 HD EX + I-I of 0.28Lsha.PRF



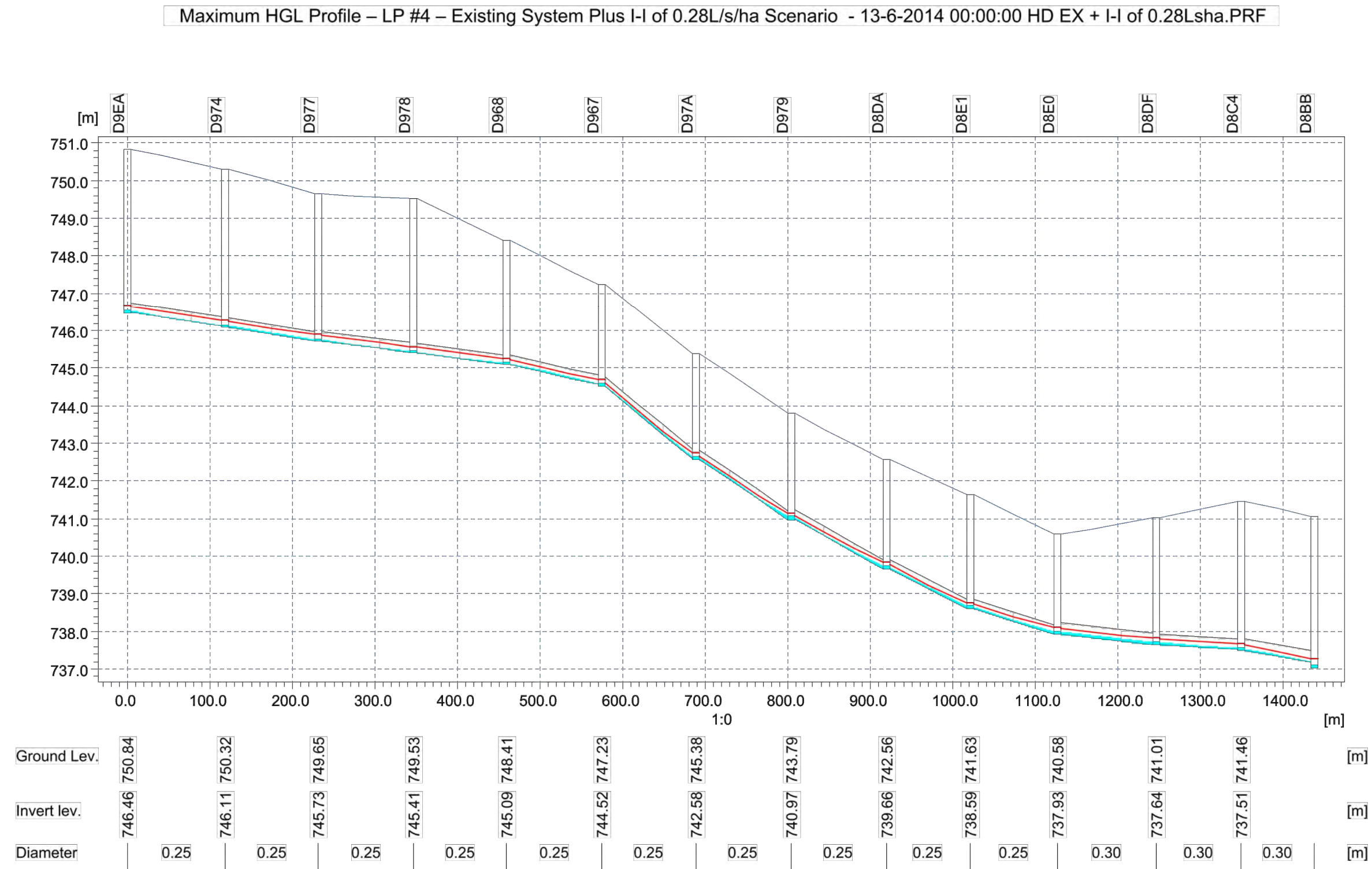
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #4  
EXISTING TRUNK SEWER



RAFAL JADZINSKI Apr. 7, 15 11:50:27 AM N: 26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES -I-I OF 028Lsha.DWG

FIGURE 5.4.5

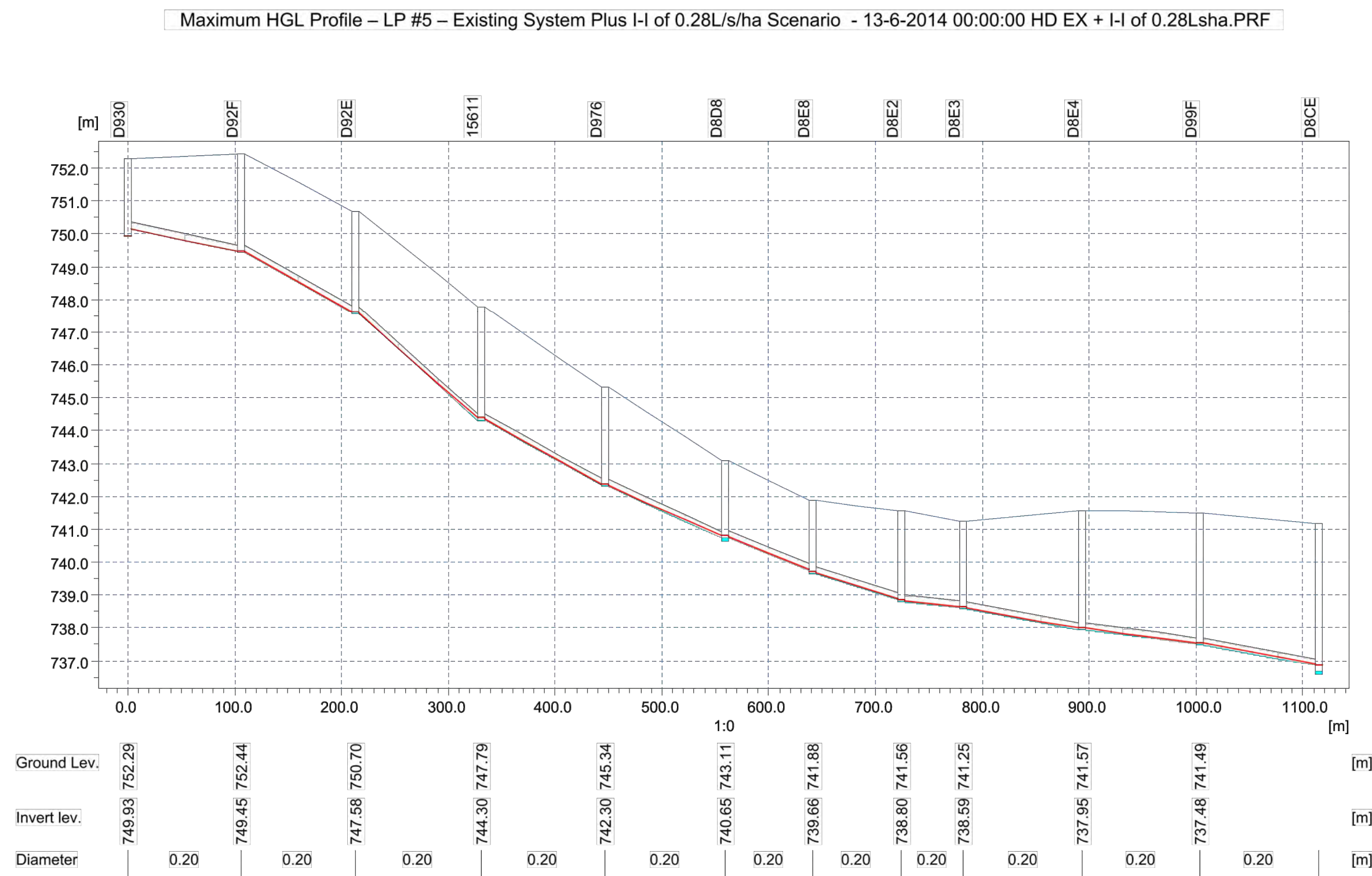
RAFAL\_JADZINSKI Apr. 7, 15 11:50:28 AM N: 26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES -I-I OF 028SHA.DWG



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #4  
EXISTING TRUNK SEWER

FIGURE 5.4.6

RAFAL JADZINSKI Apr. 7, 15 11:50:29 AM N: 26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES -I-I OF 028Lsha.DWG



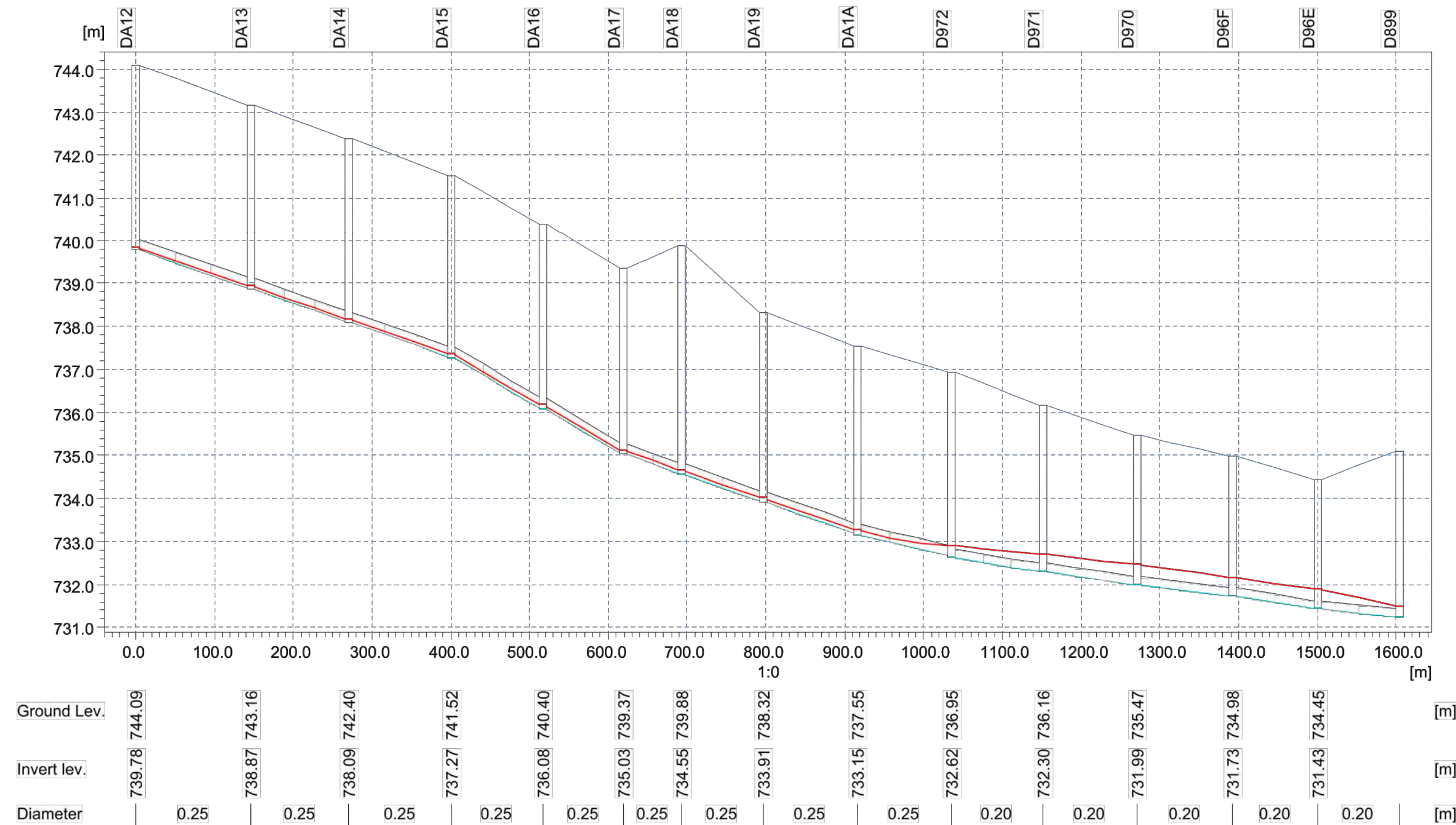
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #5  
EXISTING TRUNK SEWER





FIGURE 5.4.7

Maximum HGL Profile – LP #6 – Existing System Plus I-I of 0.28L/s/ha Scenario - 13-6-2014 00:00:00 HD EX + I-I of 0.28Lsha.PRF



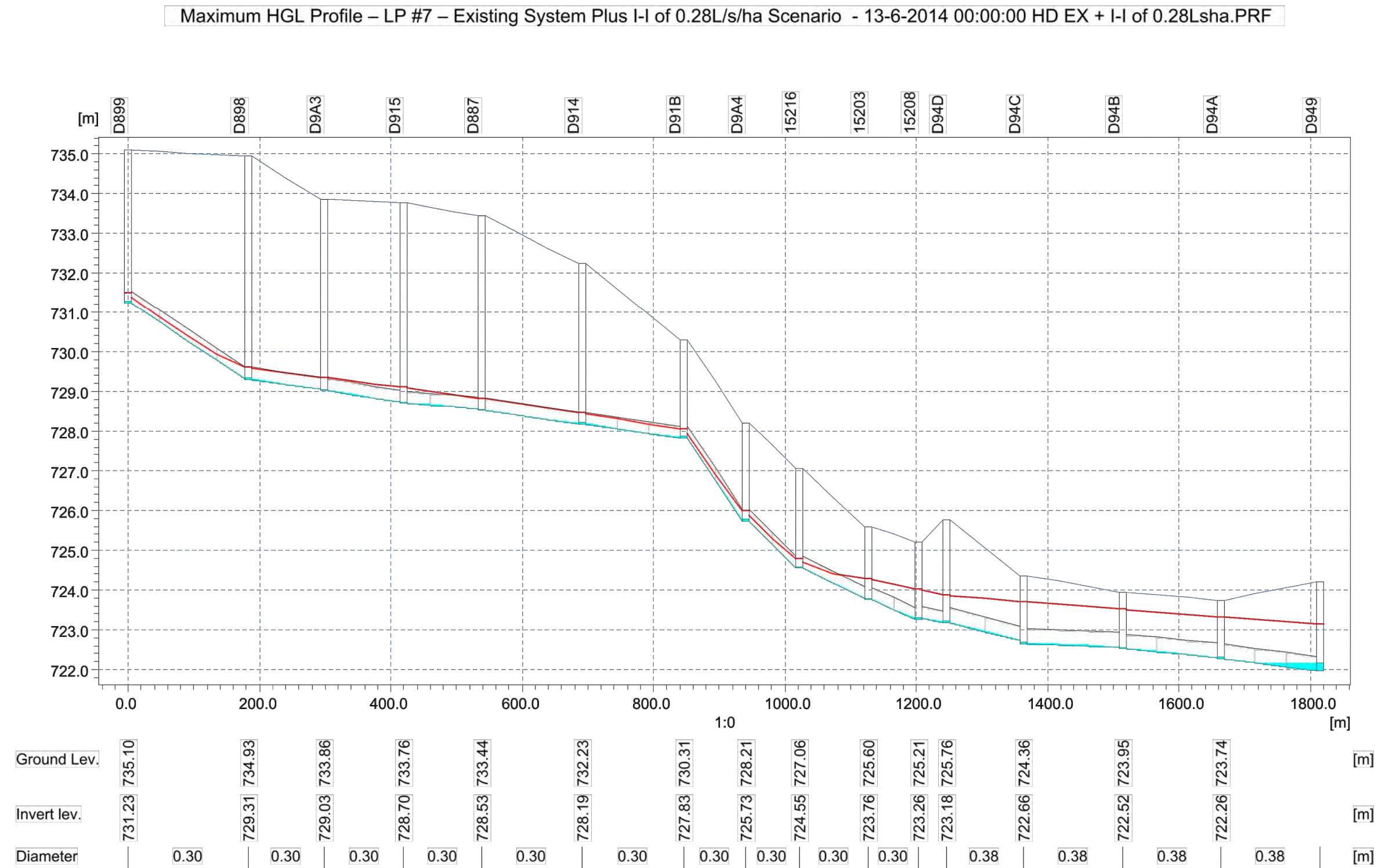
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #6  
EXISTING TRUNK SEWER





FIGURE 5.4.8

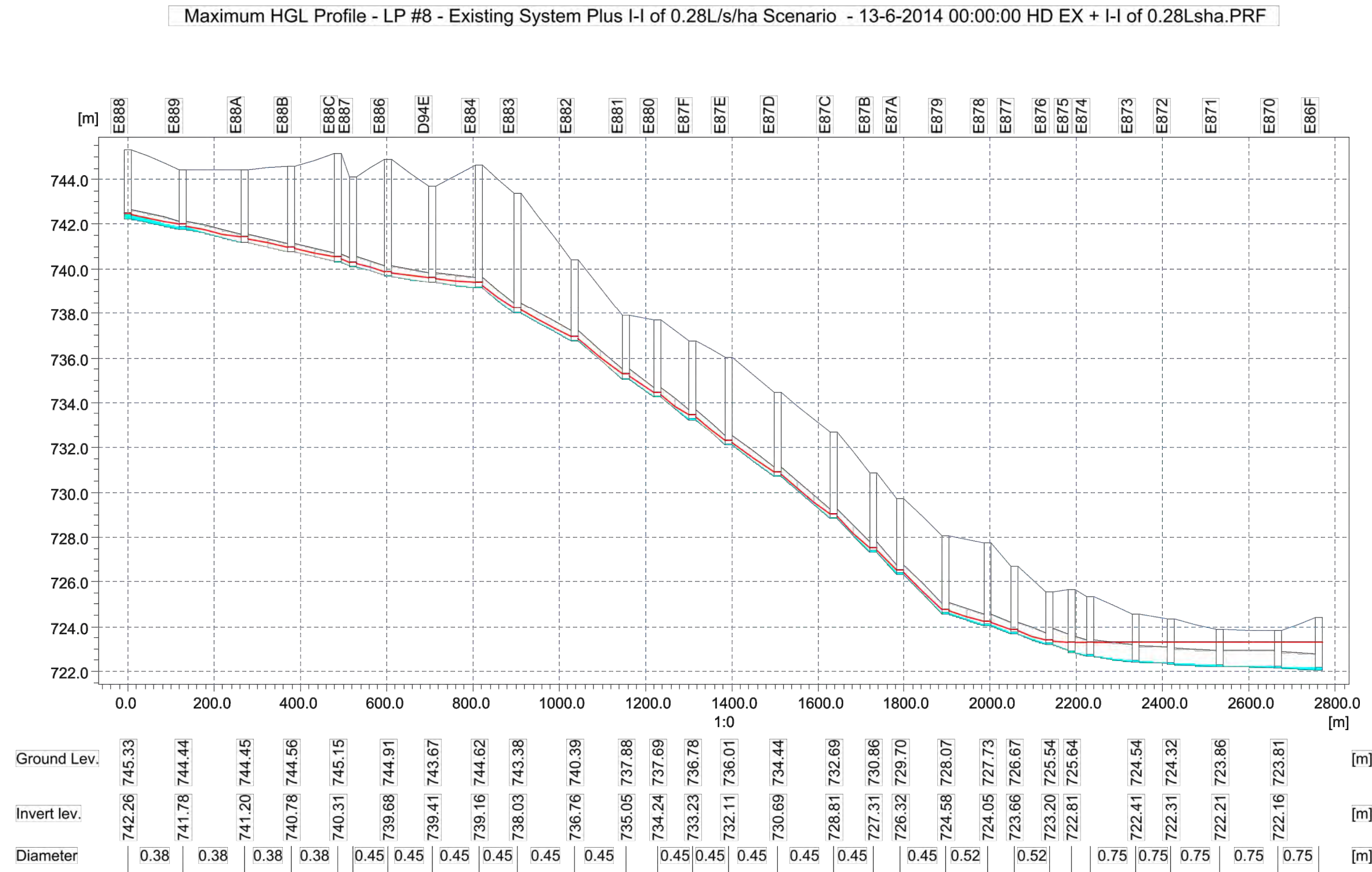
RAFAL JADZINSKI Apr. 7, 15 11:50:31 AM N:\26000\26031\_REDCLIFF\_SANITARY\J\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES - I-I OF 028LSHA.DWG



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #7  
EXISTING TRUNK SEWER

FIGURE 5.4.9

RAFAL JADZINSKI Apr. 7, 15 11:50:32 AM N: 26000\26031\_REDCLIFF\_SANITARY\_II\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES -I-I OF 028Lsha.DWG

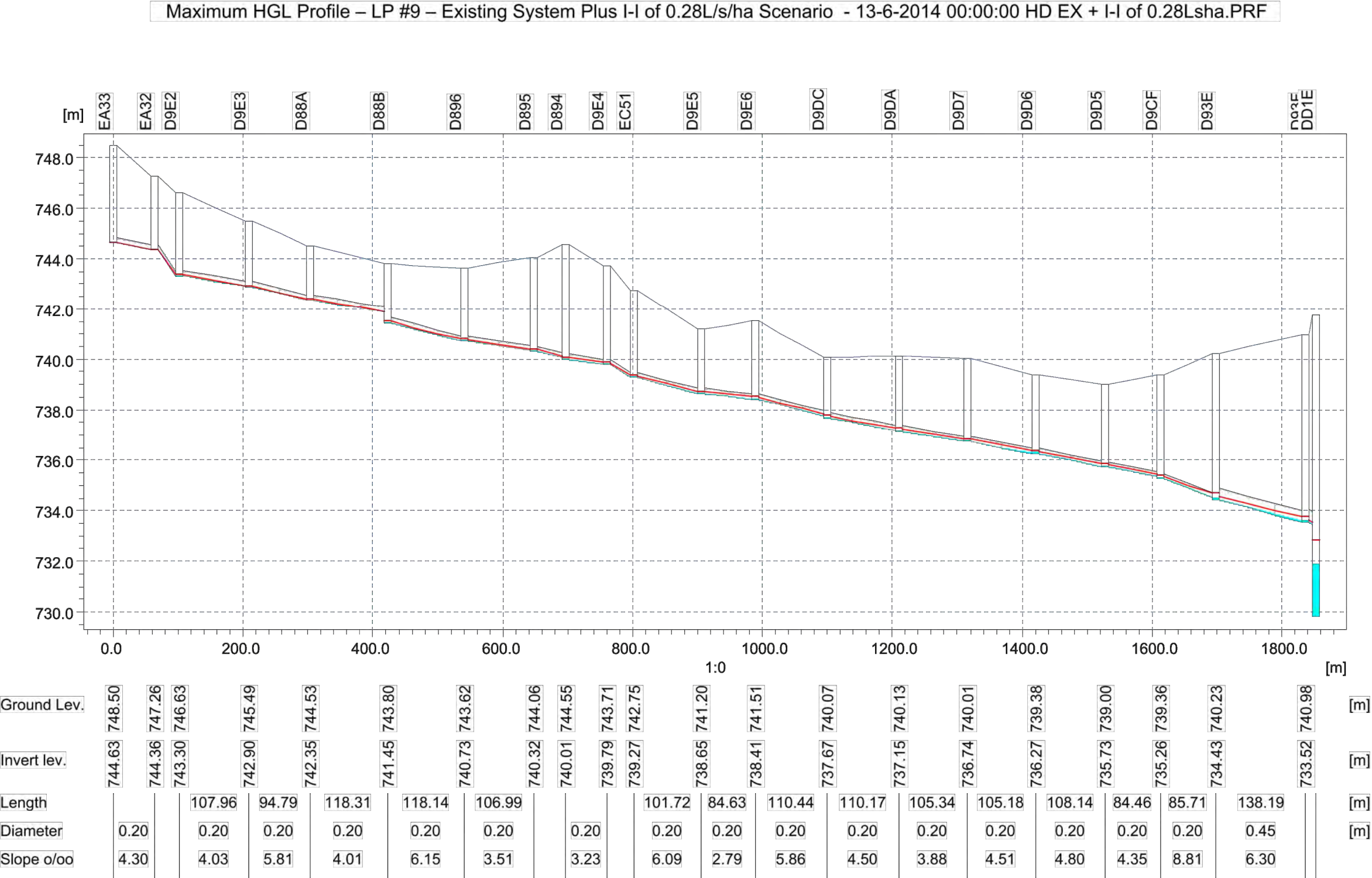


**TOWN OF REDCLIFF**  
**SANITARY II STUDY**  
II ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #8  
EXISTING TRUNK SEWER



FIGURE 5.4.10

RAFAL JADZINSKI Apr. 7, 15 11:50:34 AM N: 26000\26031\_REDCLIFF\_SANITARY\_LP#9\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES -I-I OF 028Lsha.DWG

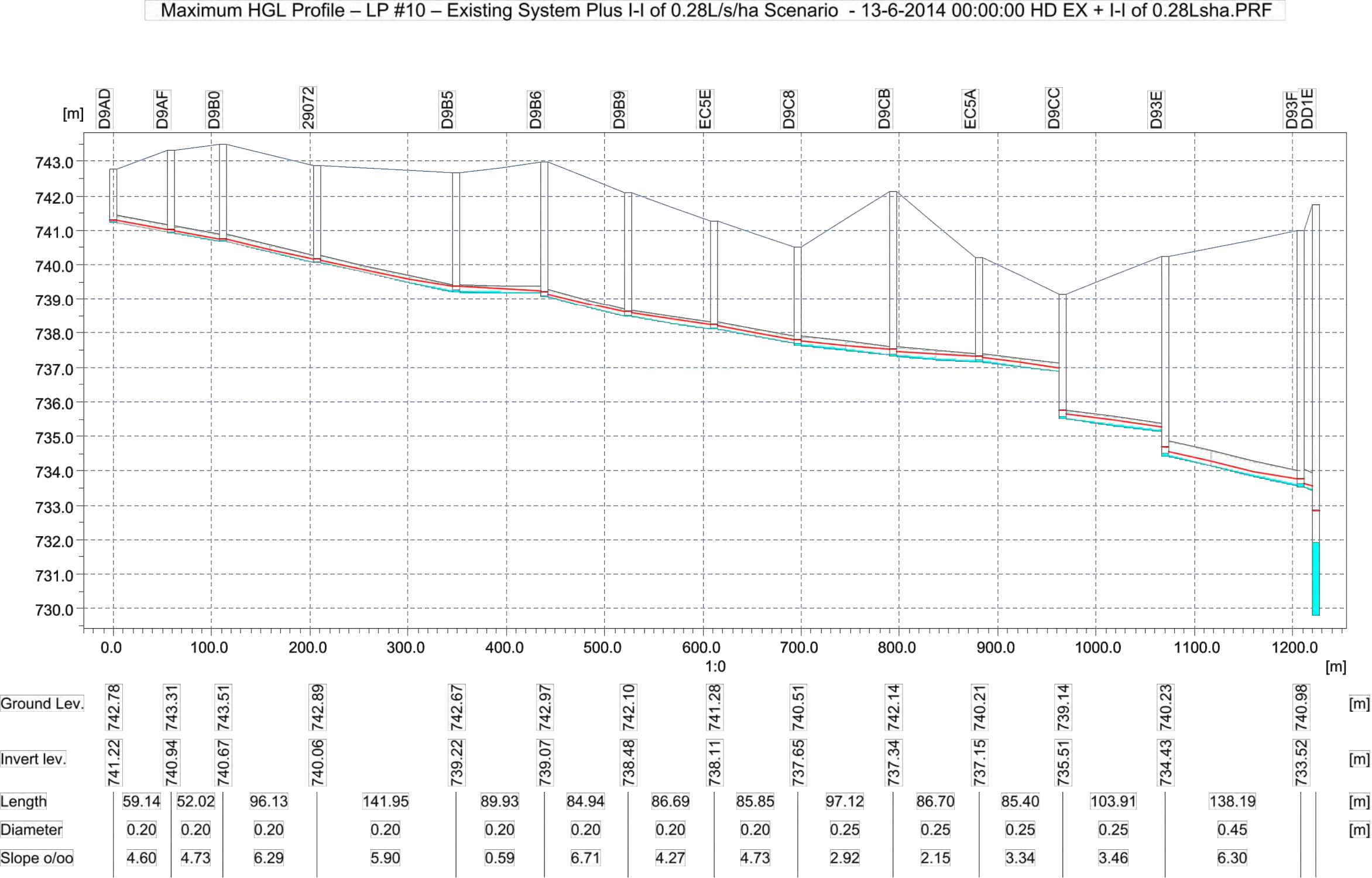


TOWN OF REDCLIFF  
SANITARY I-I STUDY  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #9  
EXISTING TRUNK SEWER



FIGURE 5.4.11

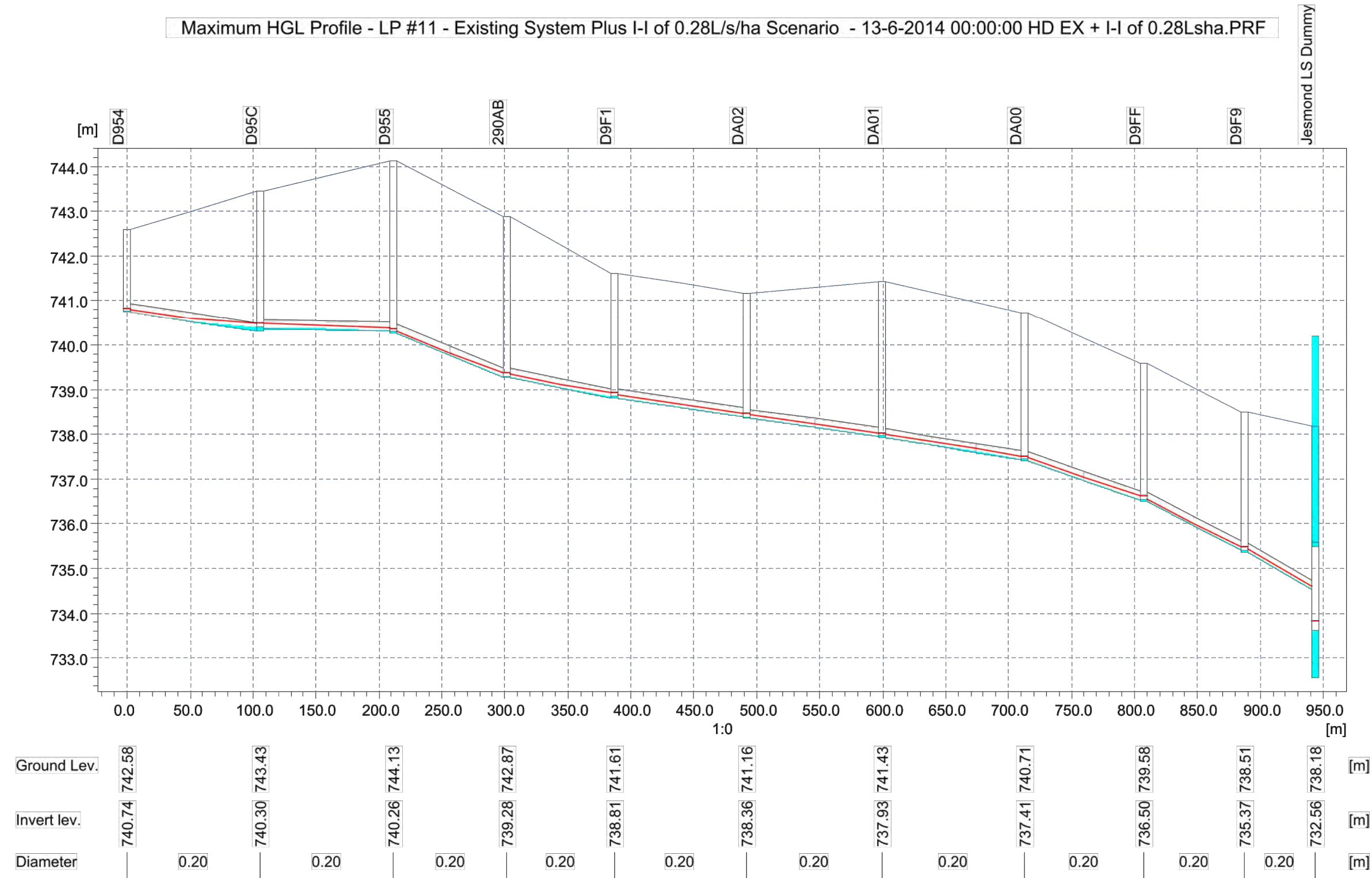
RAFAL JADZINSKI Apr. 7, 15 11:50:35 AM N: 26000\26031\_REDCLIFF\_SANITARY\_1\1\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES -I-I OF 028Lsha.DWG



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #10  
EXISTING TRUNK SEWER



FIGURE 5.4.12



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
I-I ALLOWANCE OF 0.28Lsha  
MAXIMUM HGL PROFILE - LP #11  
EXISTING TRUNK SEWER



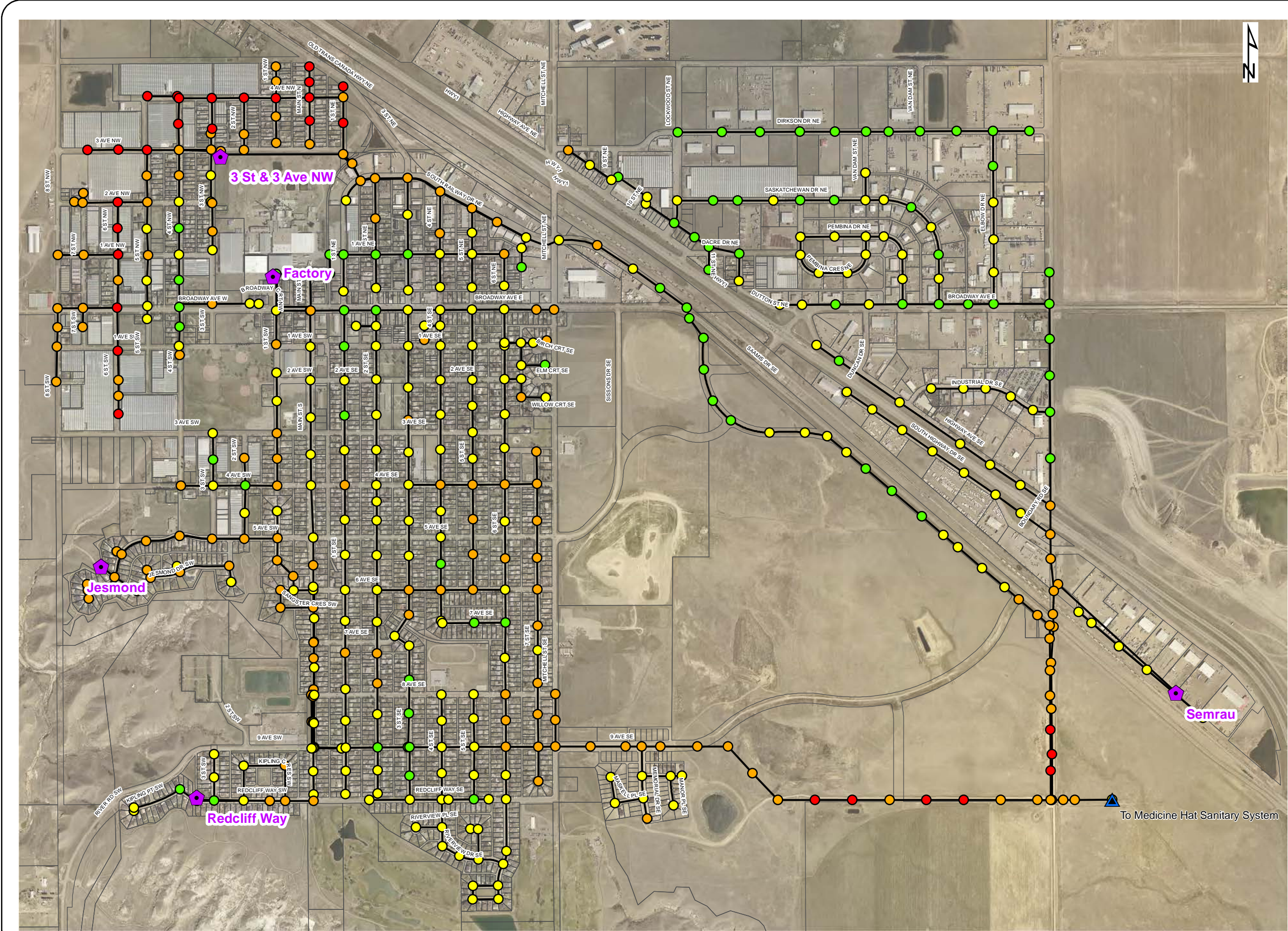
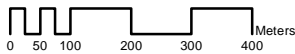


FIGURE 5.5

Legend

- Less Than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and -0.50m
- Greater Than 0.00m
- Sanitary Trunk
- Lift Station

1:12,500



TOWN OF REDCLIFF  
SANITARY I-I STUDY

PEAK HGL RELATIVE TO GROUND  
EXISTING SYSTEM PLUS  
50YR 24HR HUFF Q4 STORM





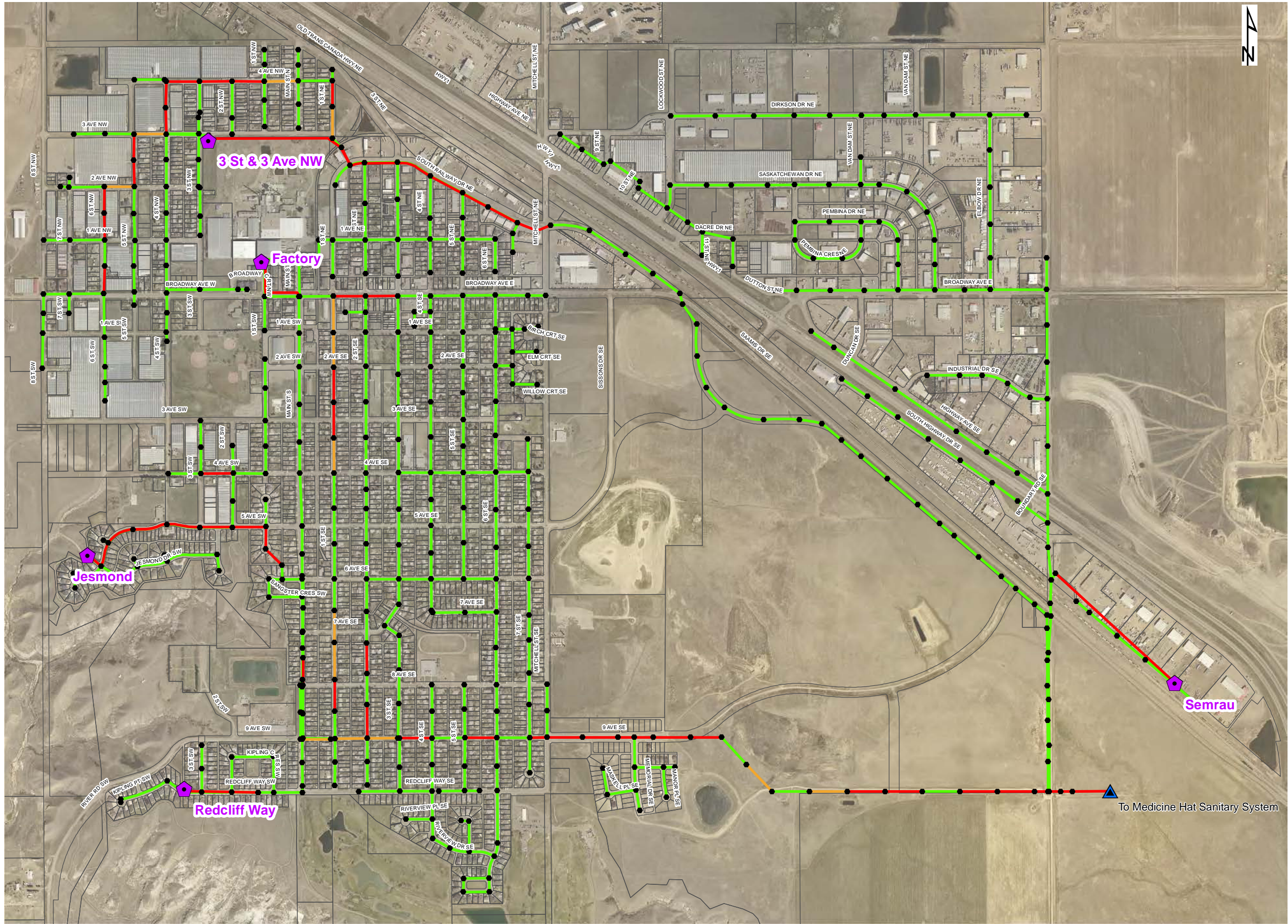
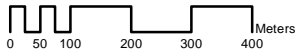


FIGURE 5.6

## Legend

- Greater Than 100%
- Between 86% and 100%
- Less Than 86%
- Lift Station

1:12,500



## TOWN OF REDCLIFF SANITARY I-I STUDY

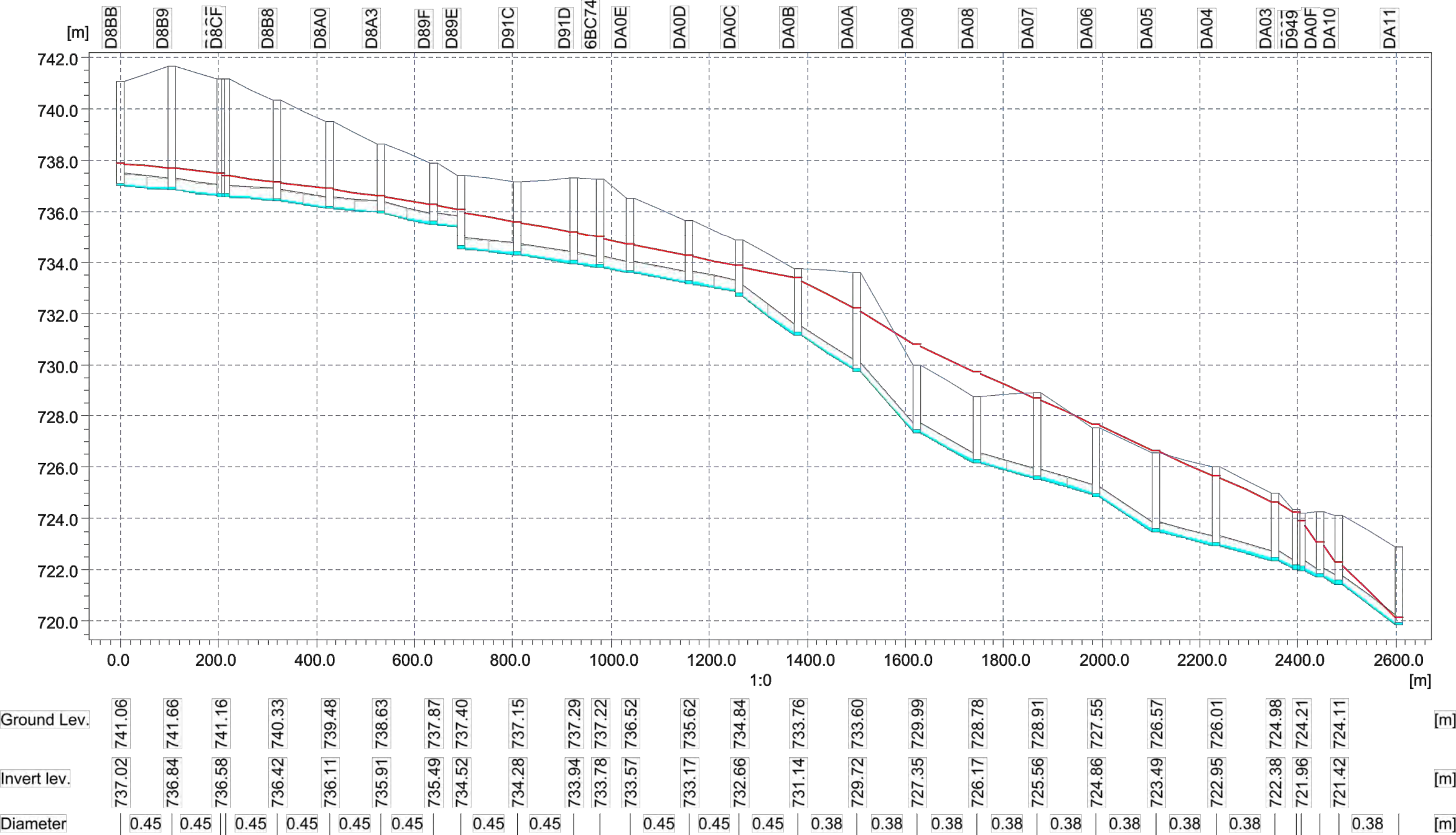
PEAK DISCHARGE RELATIVE TO PIPE CAPACITY  
EXISTING SYSTEM PLUS  
50YR 24HR HUFF Q4 STORM





FIGURE 5.7.1

Maximum HGL Profile - LP #1 - Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 21:24:00 HD Q4S EX + 50yr Huff Q4 Storm.PRF

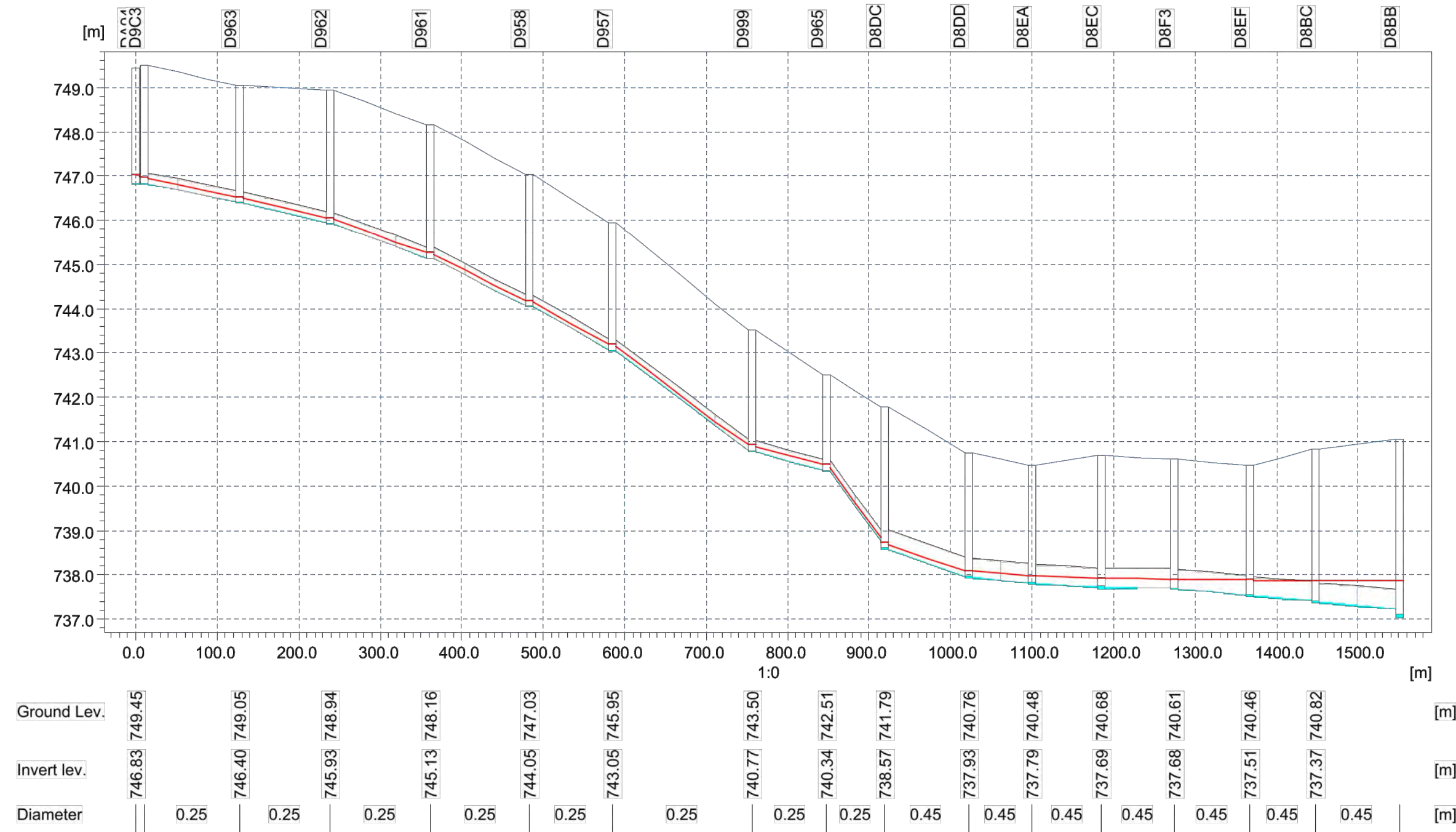


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #1**  
**EXISTING TRUNK SEWER**



FIGURE 5.7.2

Maximum HGL Profile – LP #2A – Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 21:24:00 HD Q4S EX + 50yr Huff Q4 Storm.PRF

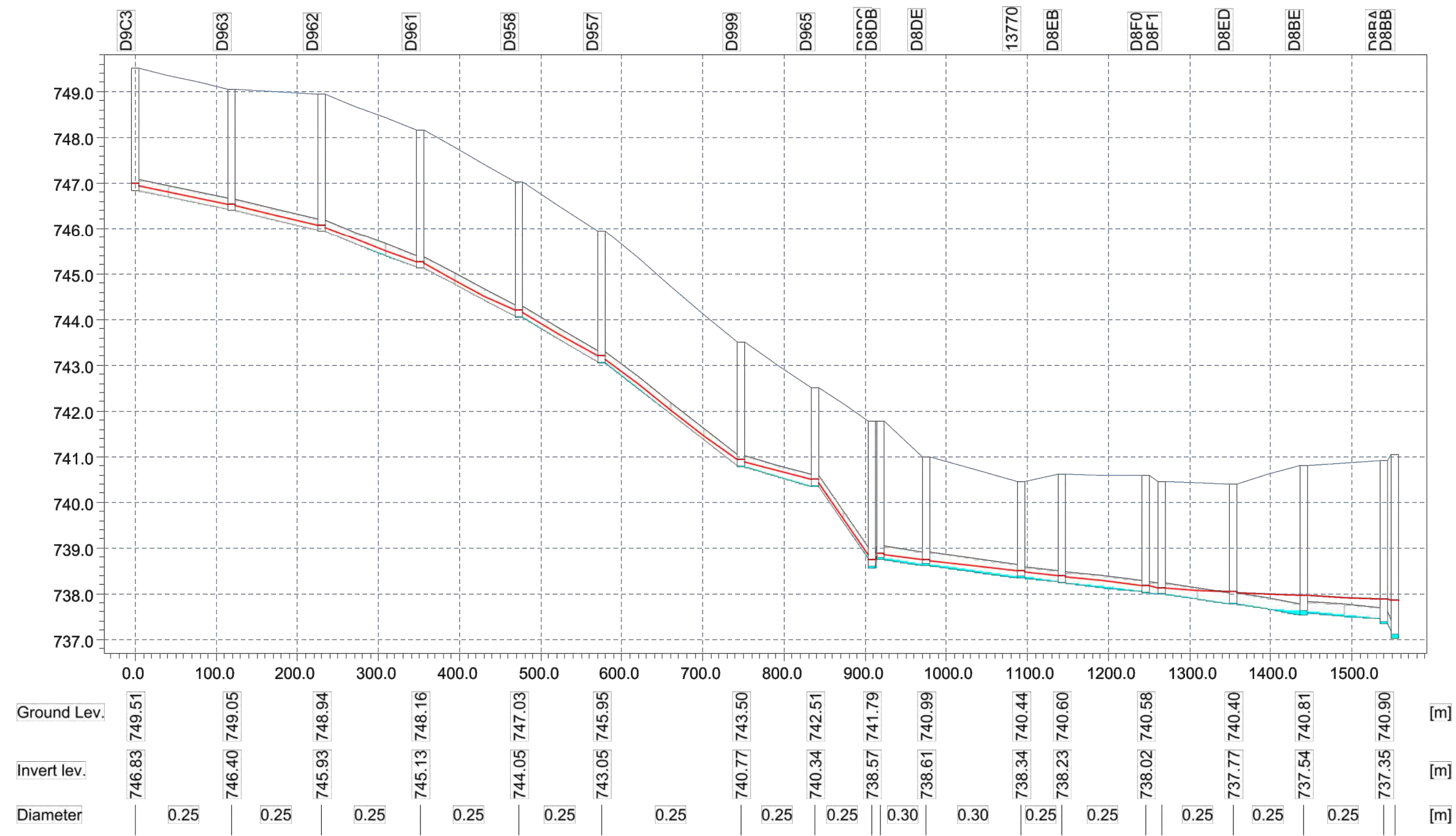


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #2A**  
**EXISTING TRUNK SEWER**

RAFAL JADZINSKI Apr. 7, 15 11:57:26 AM N: 26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES - 50YR 24HR HUFF Q4 STORM.DWG

FIGURE 5.7.3

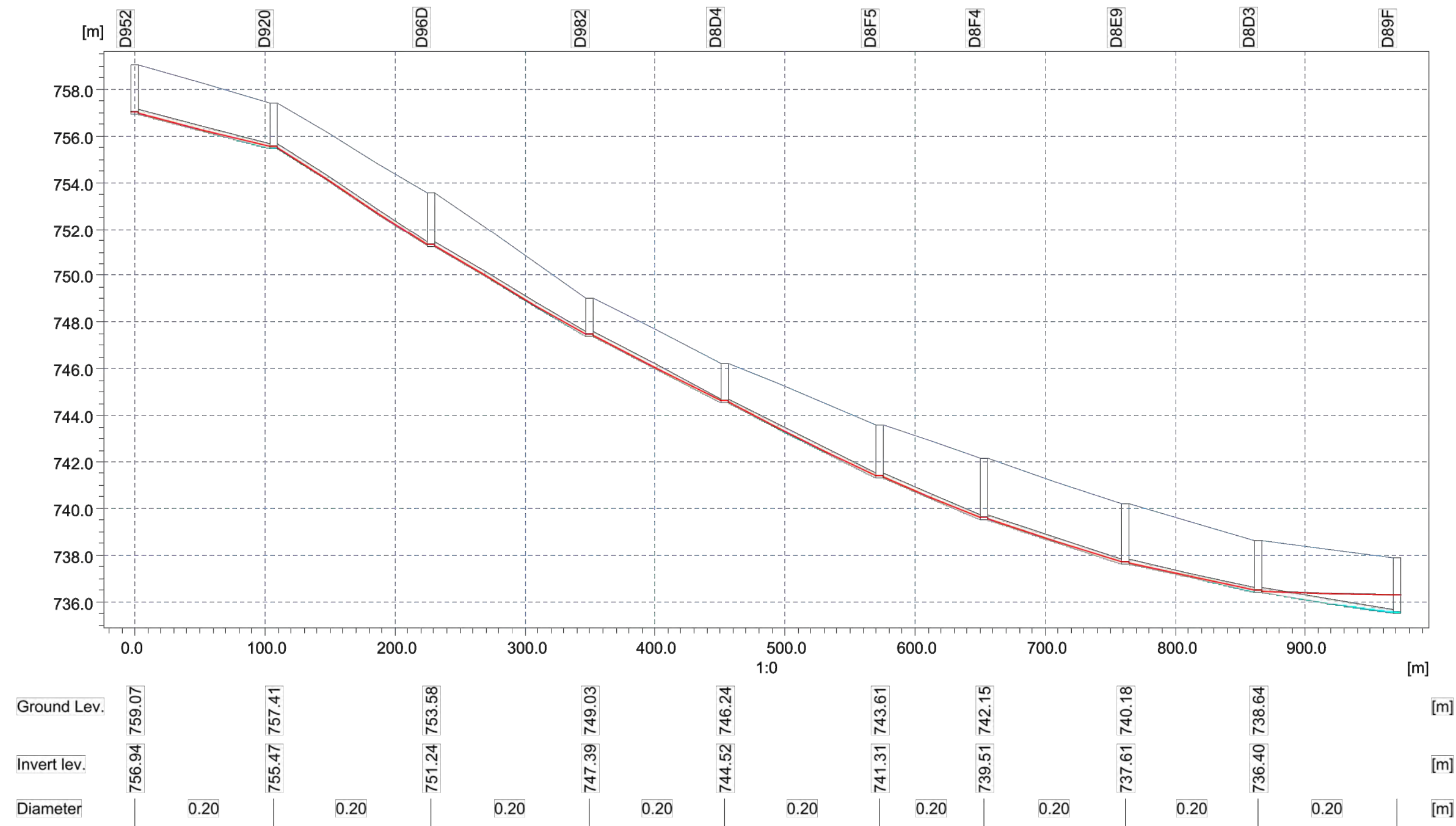
Maximum HGL Profile – LP #2B – Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 21:24:00 HD Q4S EX + 50yr Huff Q4 Storm.PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #2B**  
**EXISTING TRUNK SEWER**

FIGURE 5.7.4

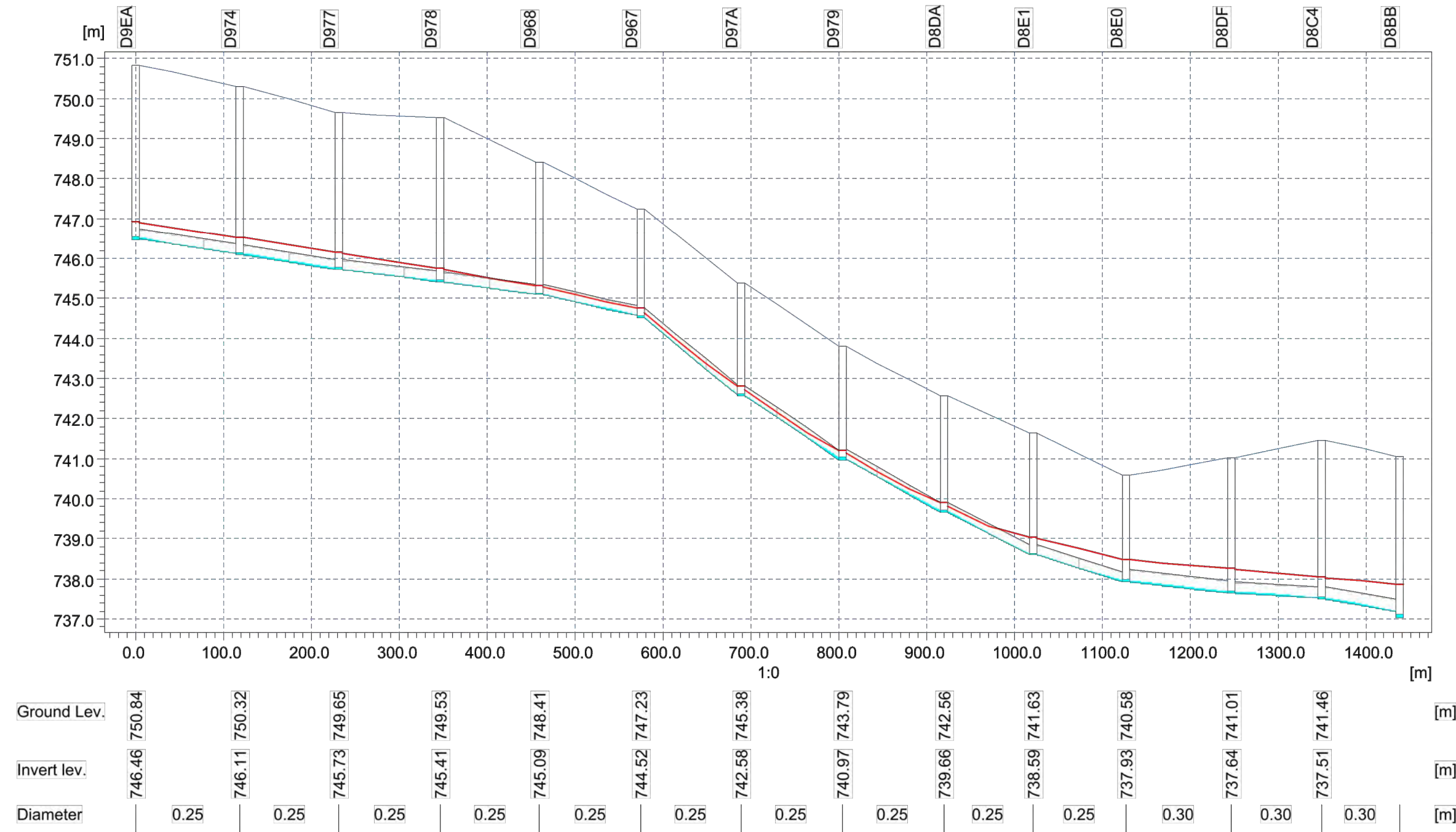
Maximum HGL Profile – LP #3 – Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 21:24:00 HD Q4S EX + 50yr Huff Q4 Storm.PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #3**  
**EXISTING TRUNK SEWER**

FIGURE 5.7.5

Maximum HGL Profile – LP #4 – Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 21:24:00 HD Q4S EX + 50yr Huff Q4 Storm.PRF



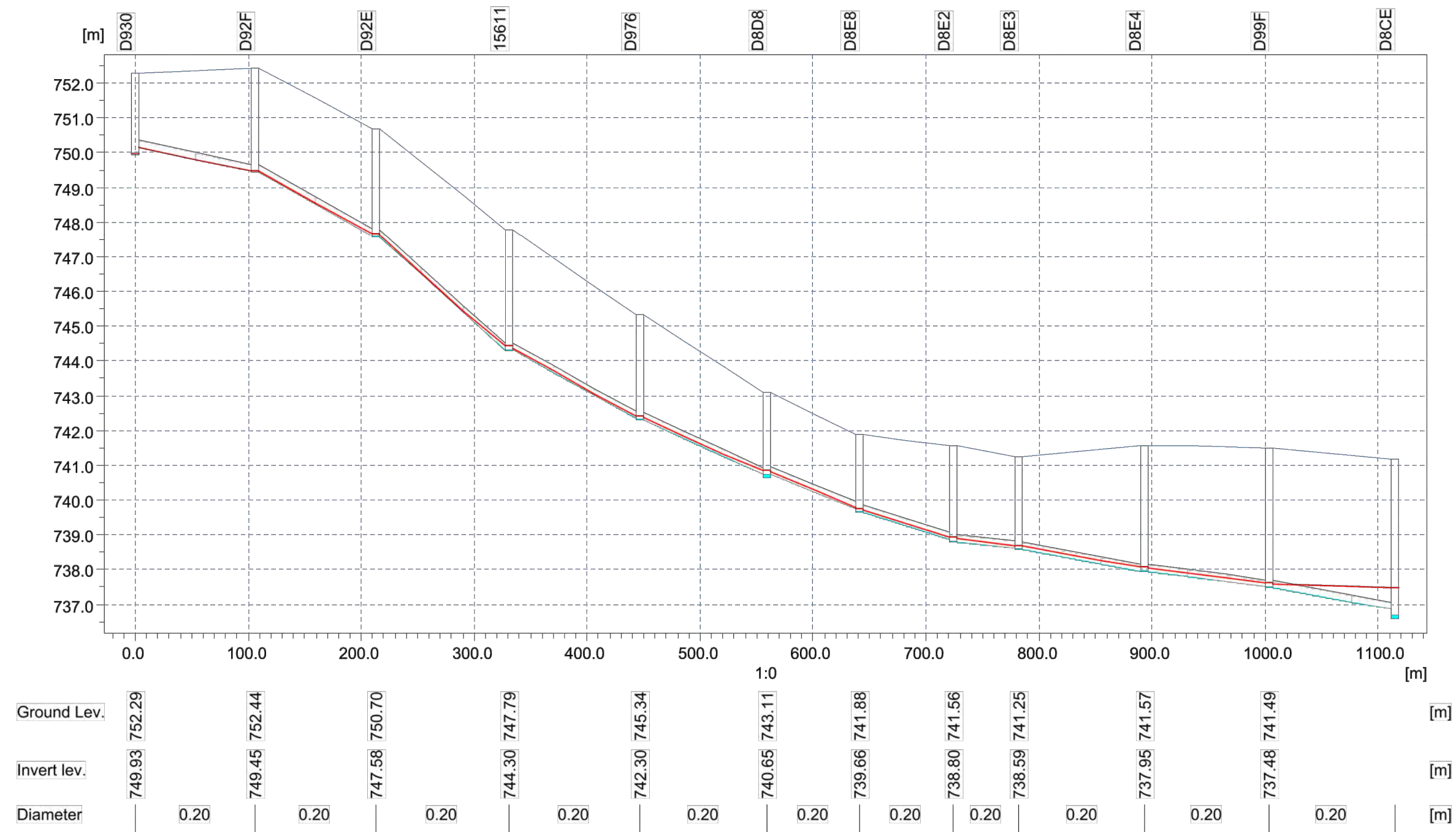
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #4**  
**EXISTING TRUNK SEWER**

RAFAL JADZINSKI Apr. 7, 15 11:57:30 AM N: 26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES - 50YR 24HR HUFF Q4 STORM.DWG



FIGURE 5.7.6

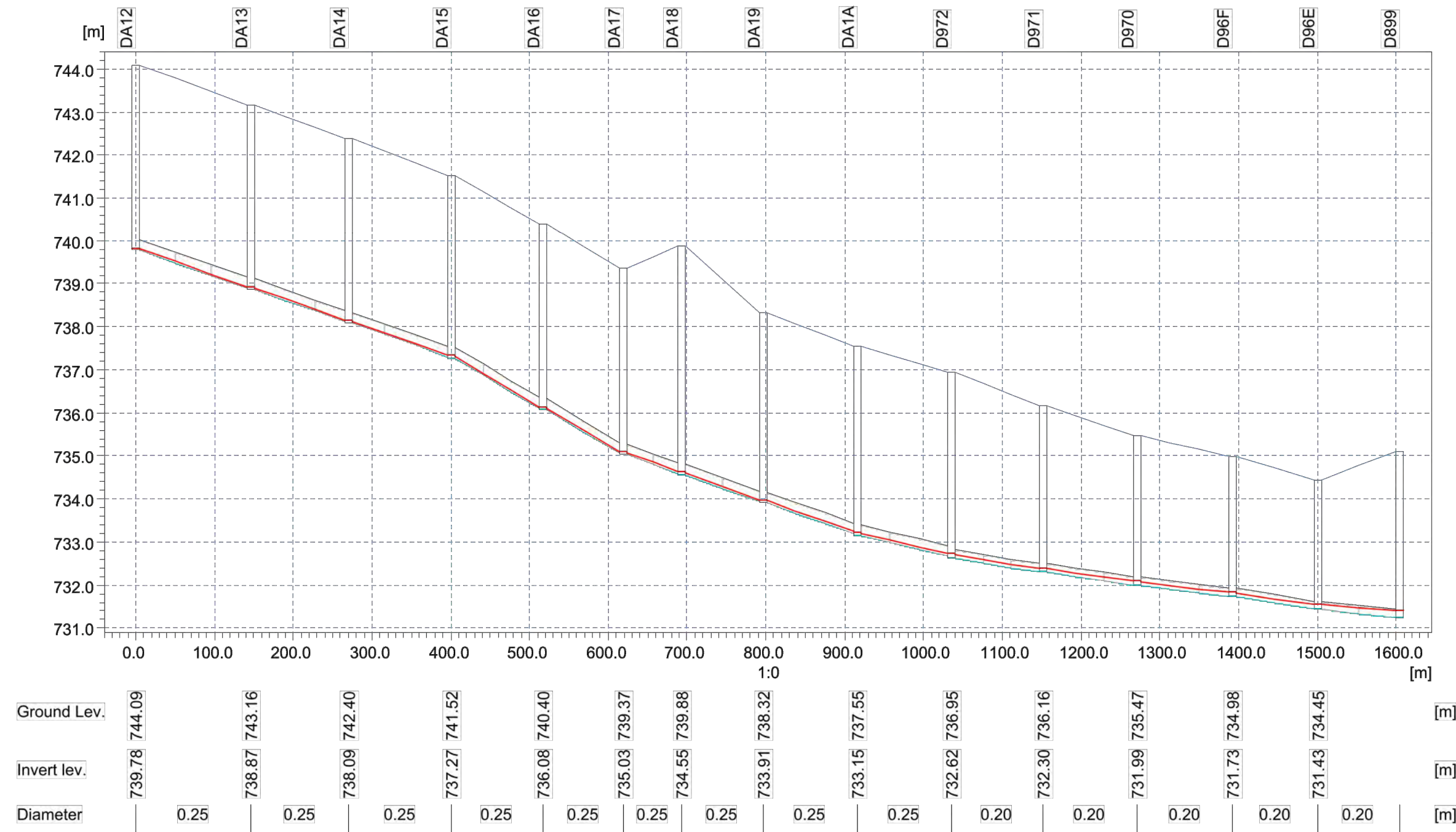
Maximum HGL Profile – LP #5 – Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 21:24:00 HD Q4S EX + 50yr Huff Q4 Storm.PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #5**  
**EXISTING TRUNK SEWER**

FIGURE 5.7.7

Maximum HGL Profile – LP #6 – Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 21:24:00 HD Q4S EX + 50yr Huff Q4 Storm.PRF

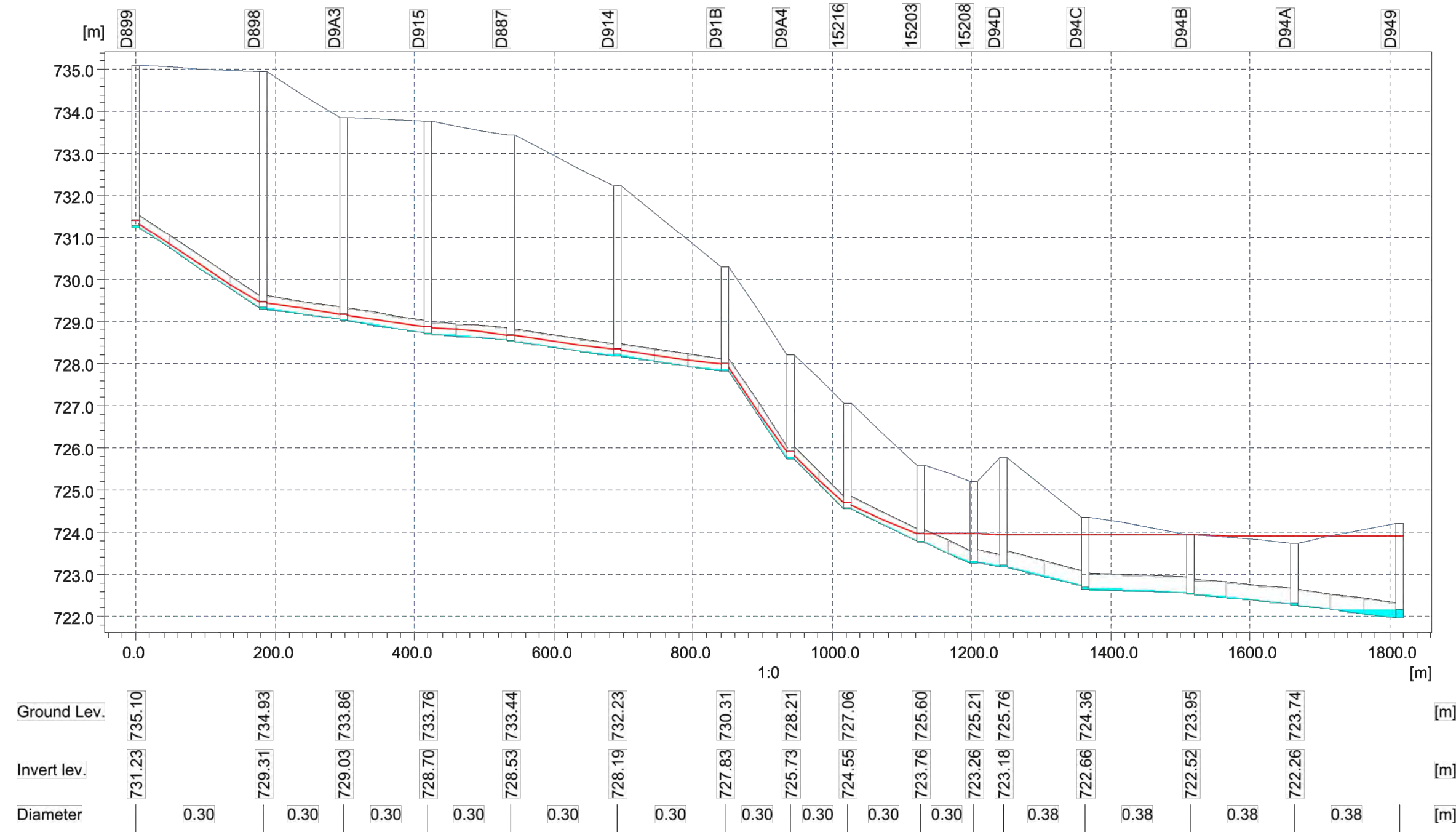


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #6**  
**EXISTING TRUNK SEWER**

RAFAL JADZINSKI Apr. 7, 15 11:57:32 AM N: 26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES - 50YR 24HR HUFF Q4 STORM.DWG

FIGURE 5.7.8

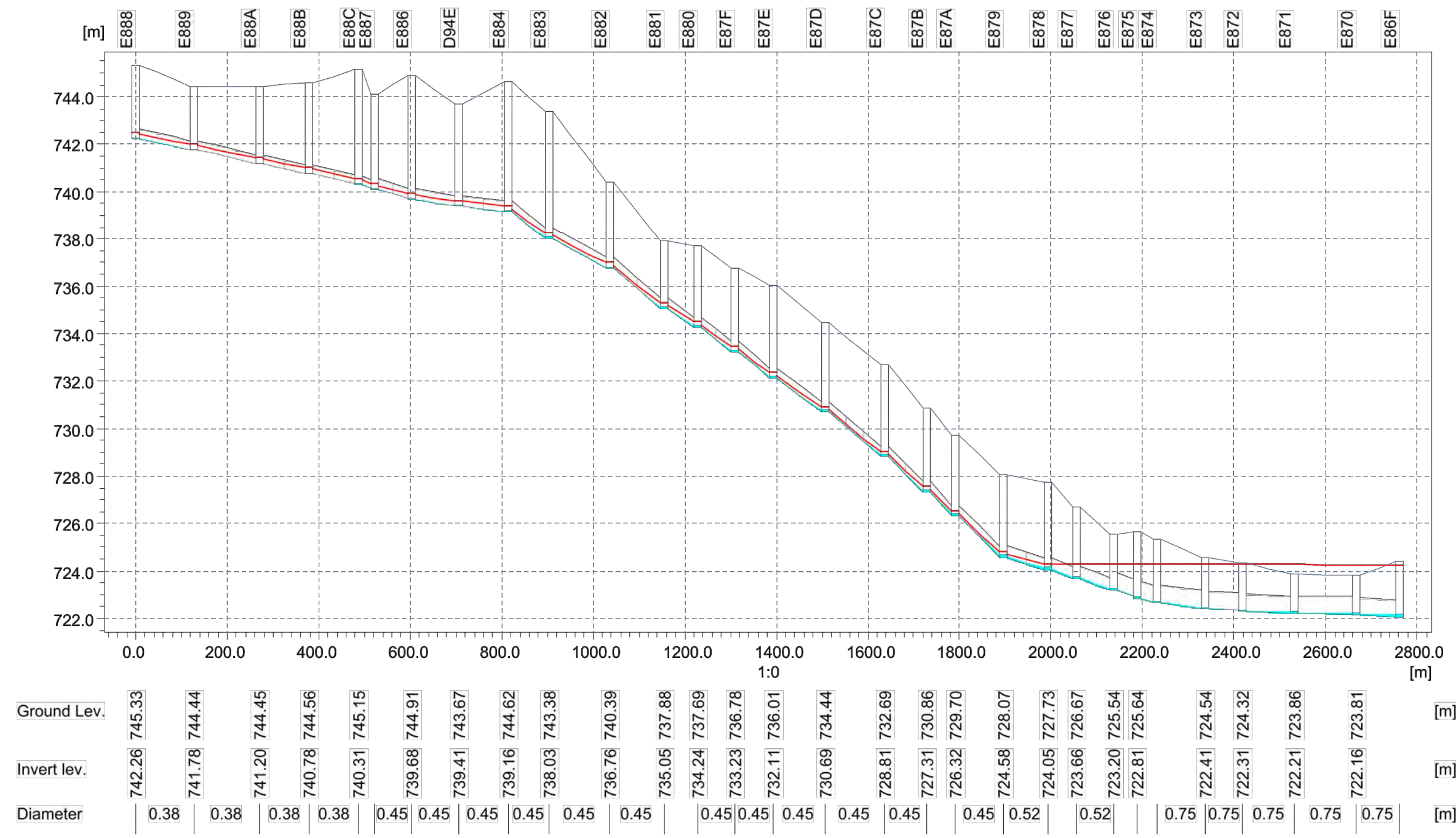
Maximum HGL Profile – LP #7 – Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 21:24:00 HD Q4S EX + 50yr Huff Q4 Storm.PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #7**  
**EXISTING TRUNK SEWER**

FIGURE 5.7.9

Maximum HGL Profile - LP #8 - Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 23:59:33 HD Q4S EX + 50yr Huff Q4 Storm.PRF



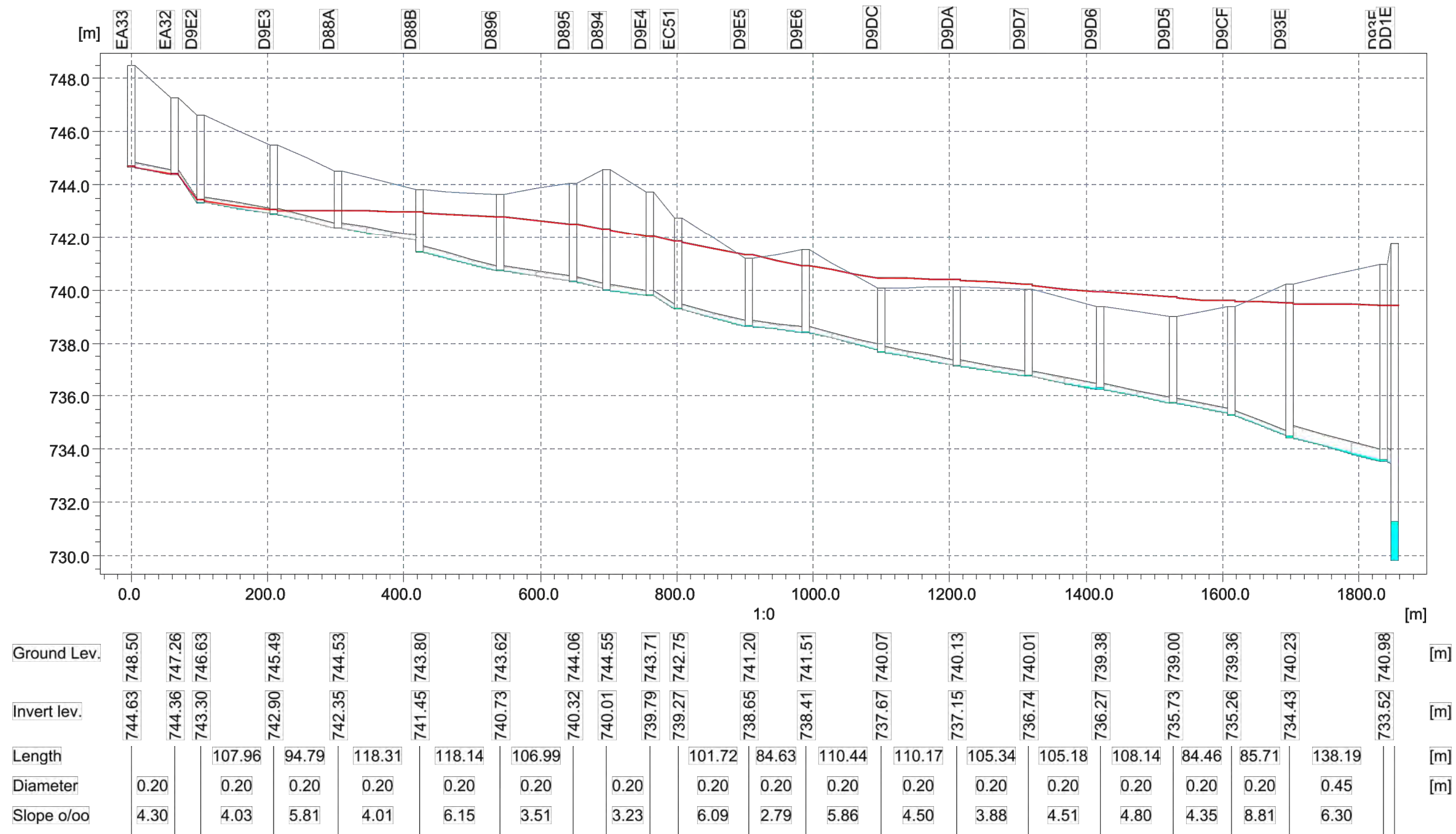
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #8**  
**EXISTING TRUNK SEWER**

RAFAL JADZINSKI Apr. 7, 15 11:57:34 AM N: 26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES - 50YR 24HR HUFF Q4 STORM.DWG



FIGURE 5.7.10

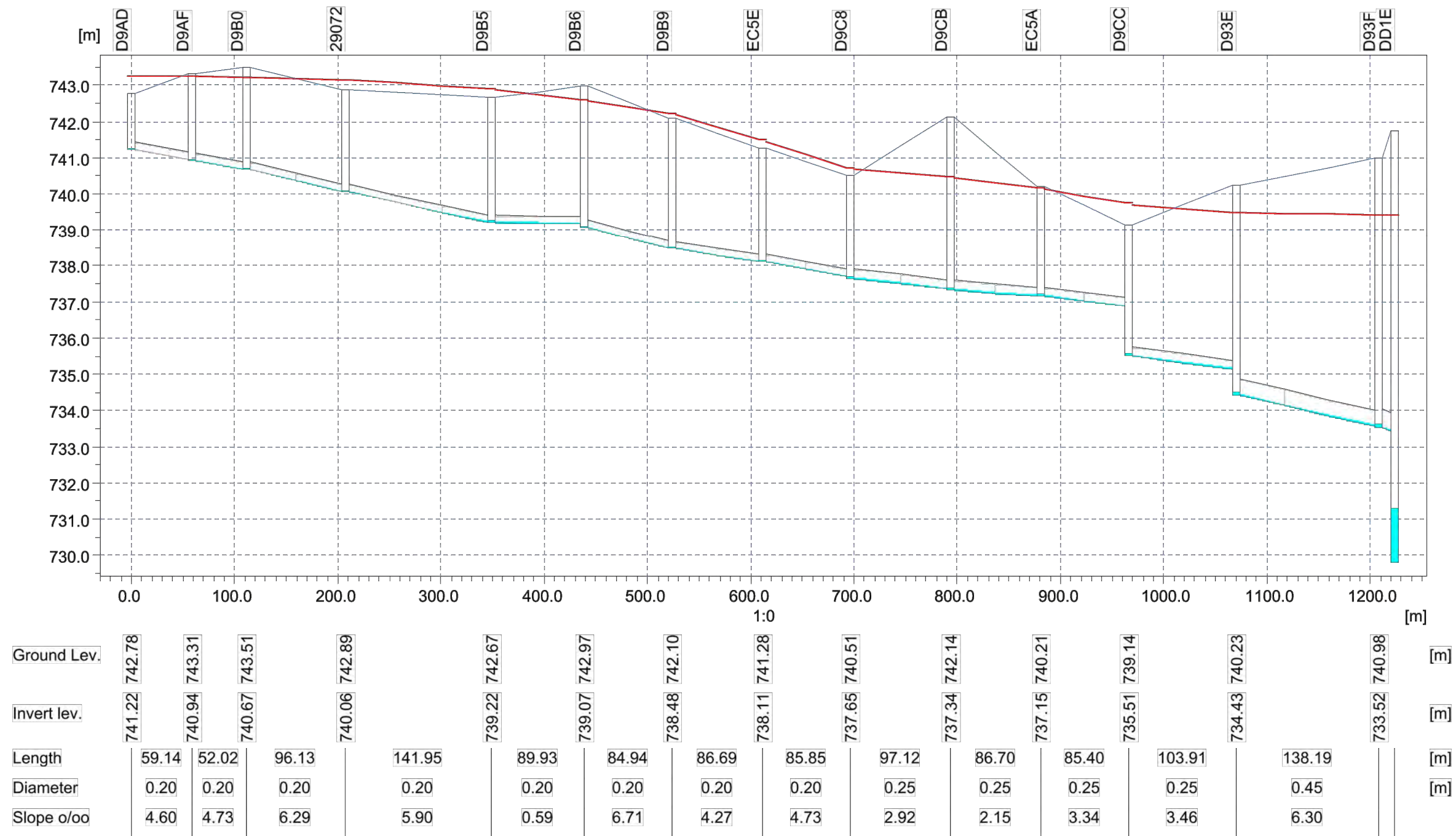
Maximum HGL Profile – LP #9 – Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 21:24:00 HD Q4S EX + 50yr Huff Q4 Storm.PRF



TOWN OF REDCLIFF  
SANITARY I-I STUDY  
50YR 24HR HUFF Q4 STORM  
MAXIMUM HGL PROFILE - LP #9  
EXISTING TRUNK SEWER

FIGURE 5.7.11

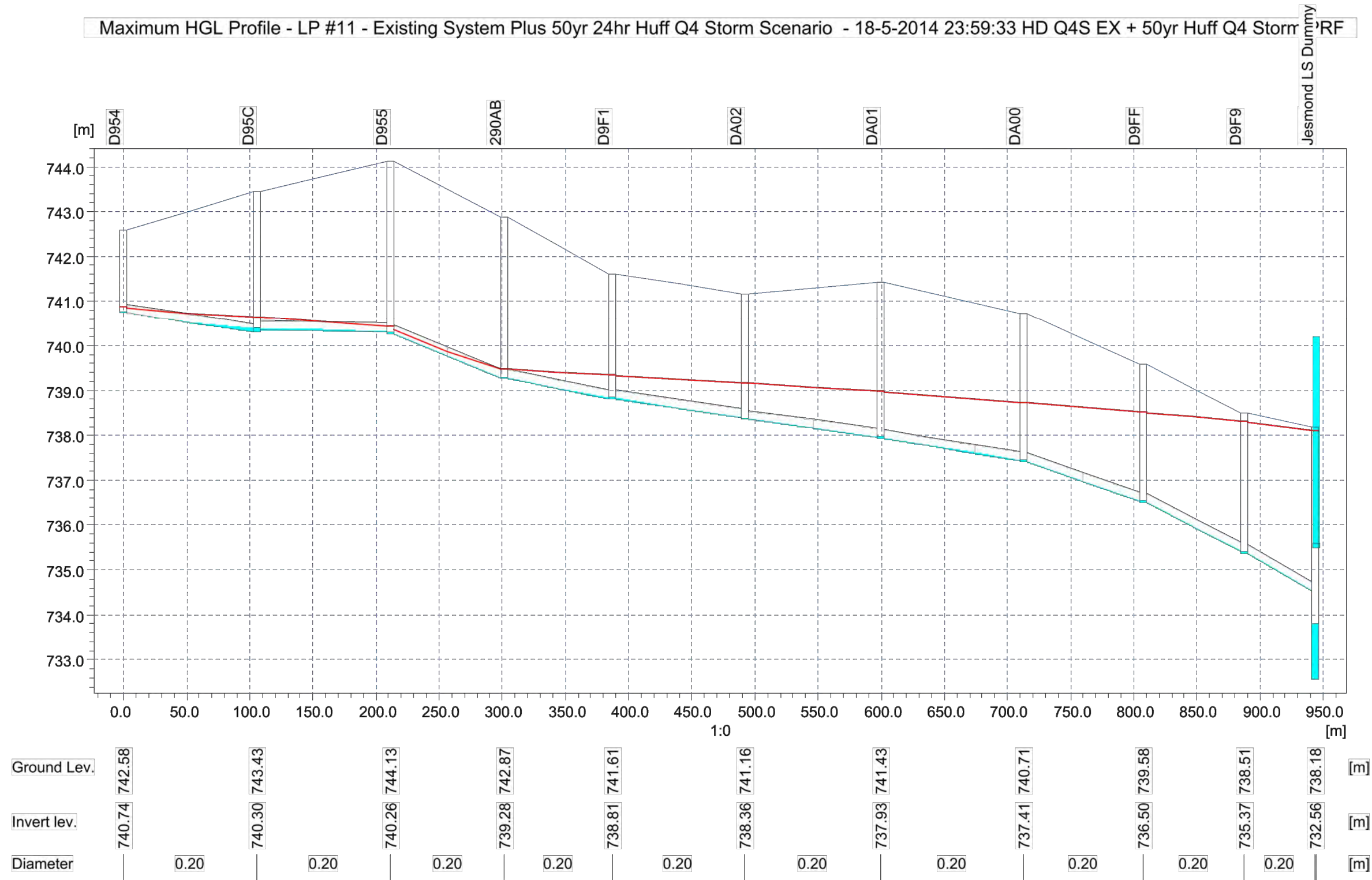
Maximum HGL Profile – LP #10 – Existing System Plus 50yr 24hr Huff Q4 Storm Scenario - 18-5-2014 21:24:00 HD Q4S EX + 50yr Huff Q4 Storm.PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #10**  
**EXISTING TRUNK SEWER**

FIGURE 5.7.12

RAFAL JADZINSKI Apr. 7, 15 11:57:37 AM N: 26000\26031\_REDCLIFF\_SANITARY\_11\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES - 50YR 24HR HUFF Q4 STORM.DWG



**TOWN OF REDCLIFF**  
**SANITARY STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MAXIMUM HGL PROFILE - LP #11**  
**EXISTING TRUNK SEWER**





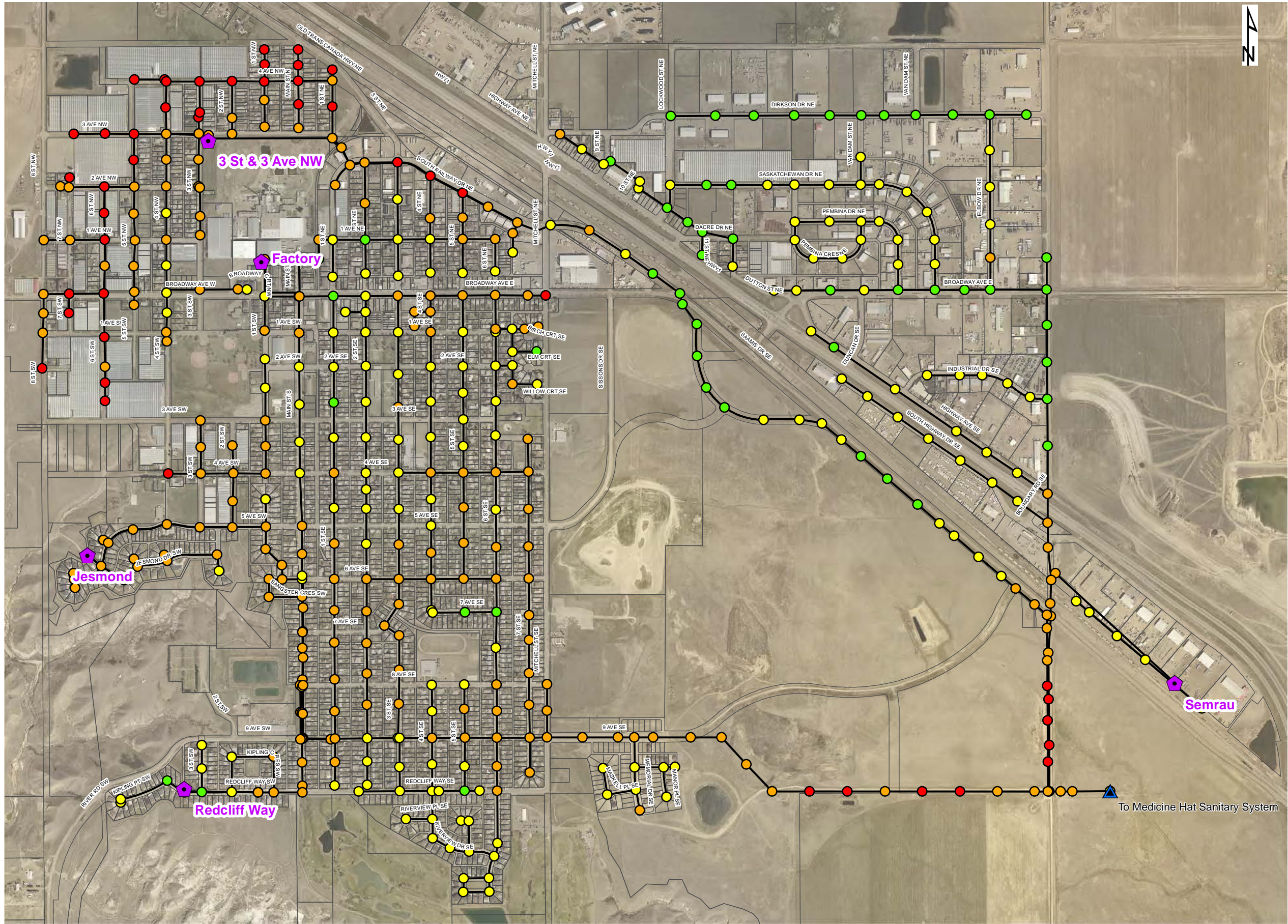
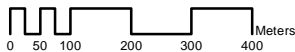


FIGURE 5.8

## Legend

- Less Than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and -0.50m
- Greater Than 0.00m
- Sanitary Trunk
- Lift Station

1:12,500



### TOWN OF REDCLIFF SANITARY I-I STUDY

PEAK HGL RELATIVE TO GROUND  
EXISTING SYSTEM PLUS  
JULY 6 2013 THUNDERSTORM





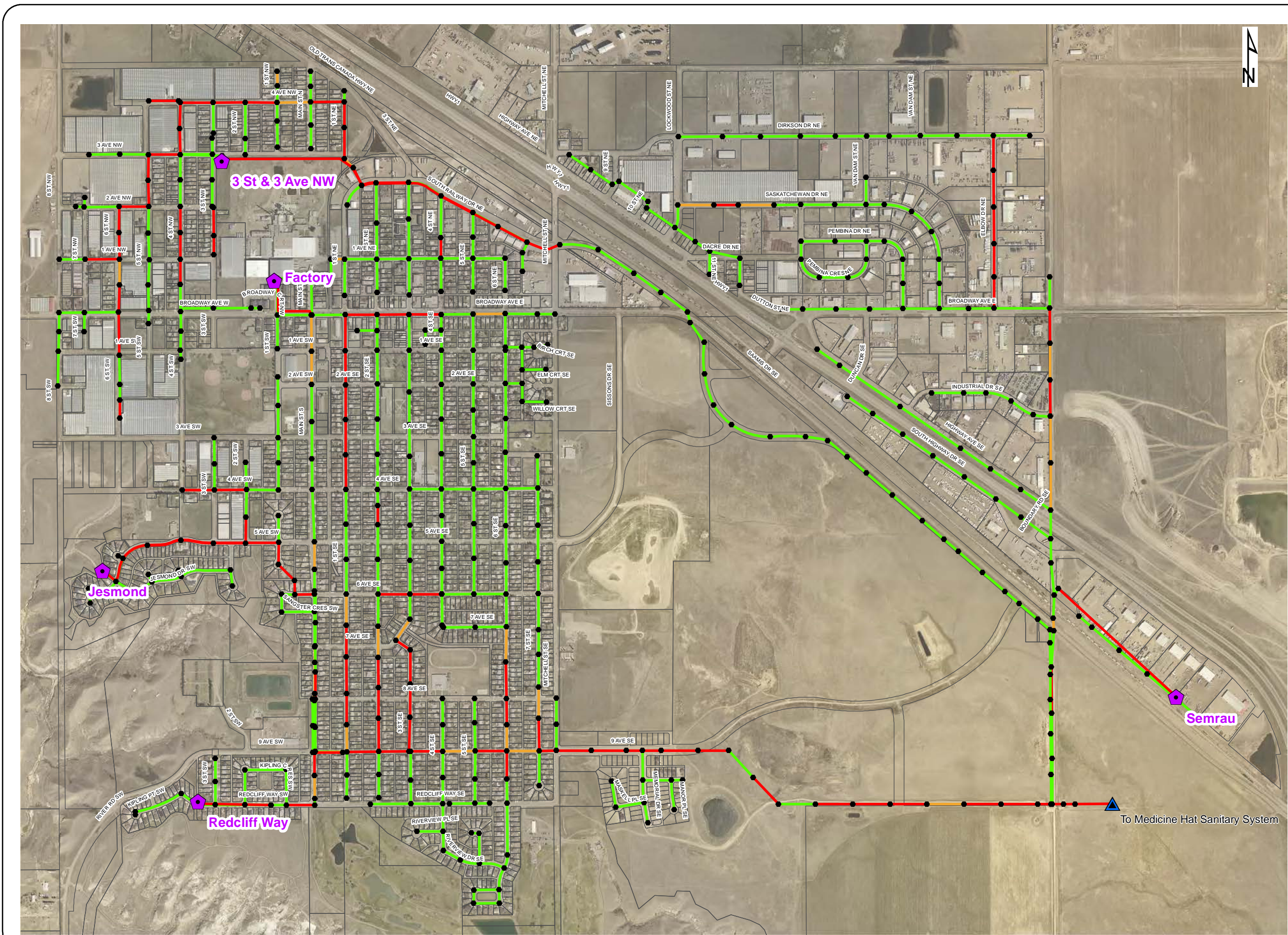
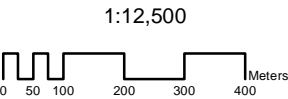


FIGURE 5.9

Legend

- Greater Than 100%
- Between 86% and 100%
- Less Than 86%
- Lift Station



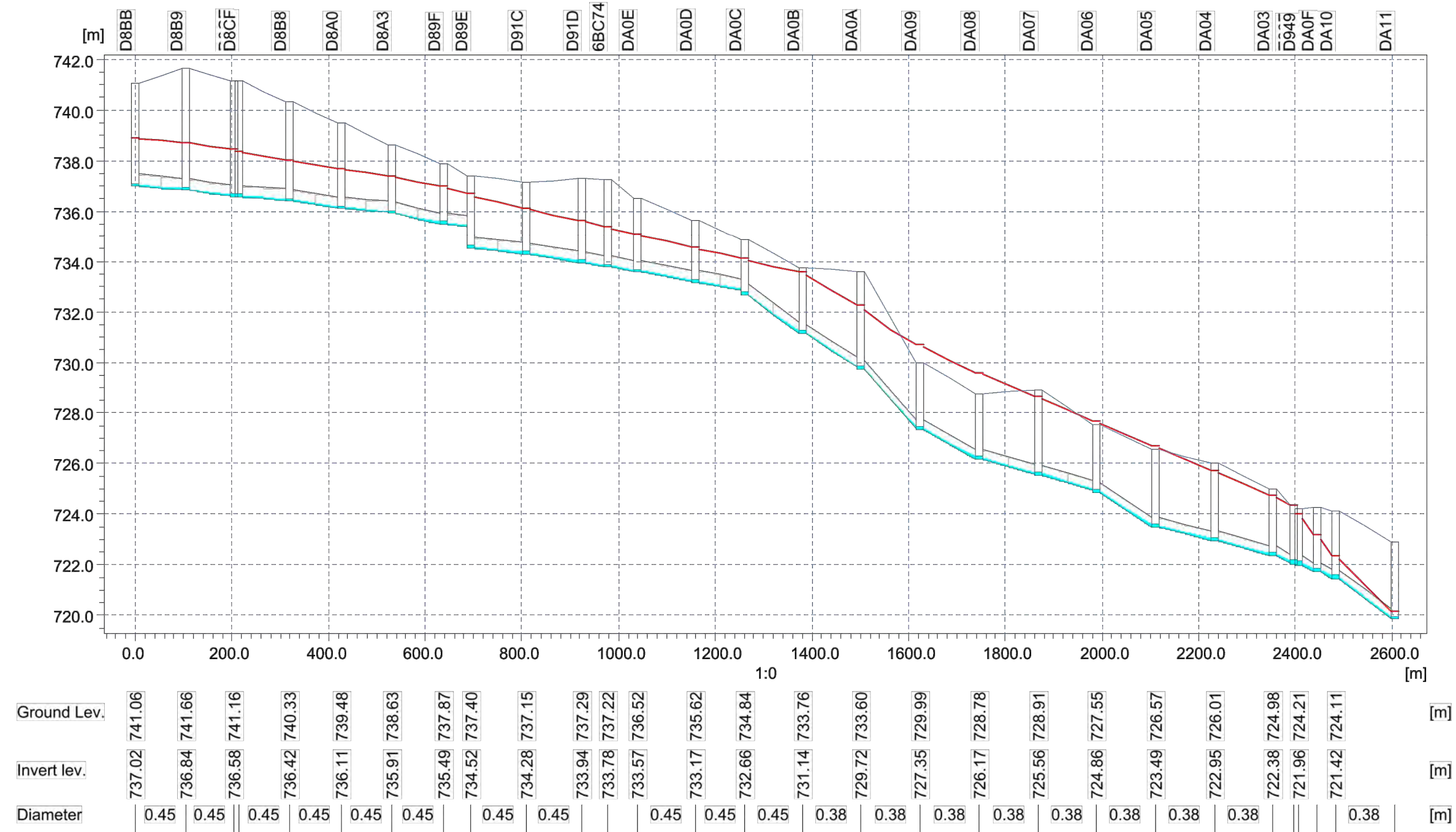
TOWN OF REDCLIFF  
SANITARY I-I STUDY  
PEAK DISCHARGE RELATIVE TO PIPE CAPACITY  
EXISTING SYSTEM PLUS  
JULY 6 2013 THUNDERSTORM





FIGURE 5.10.1

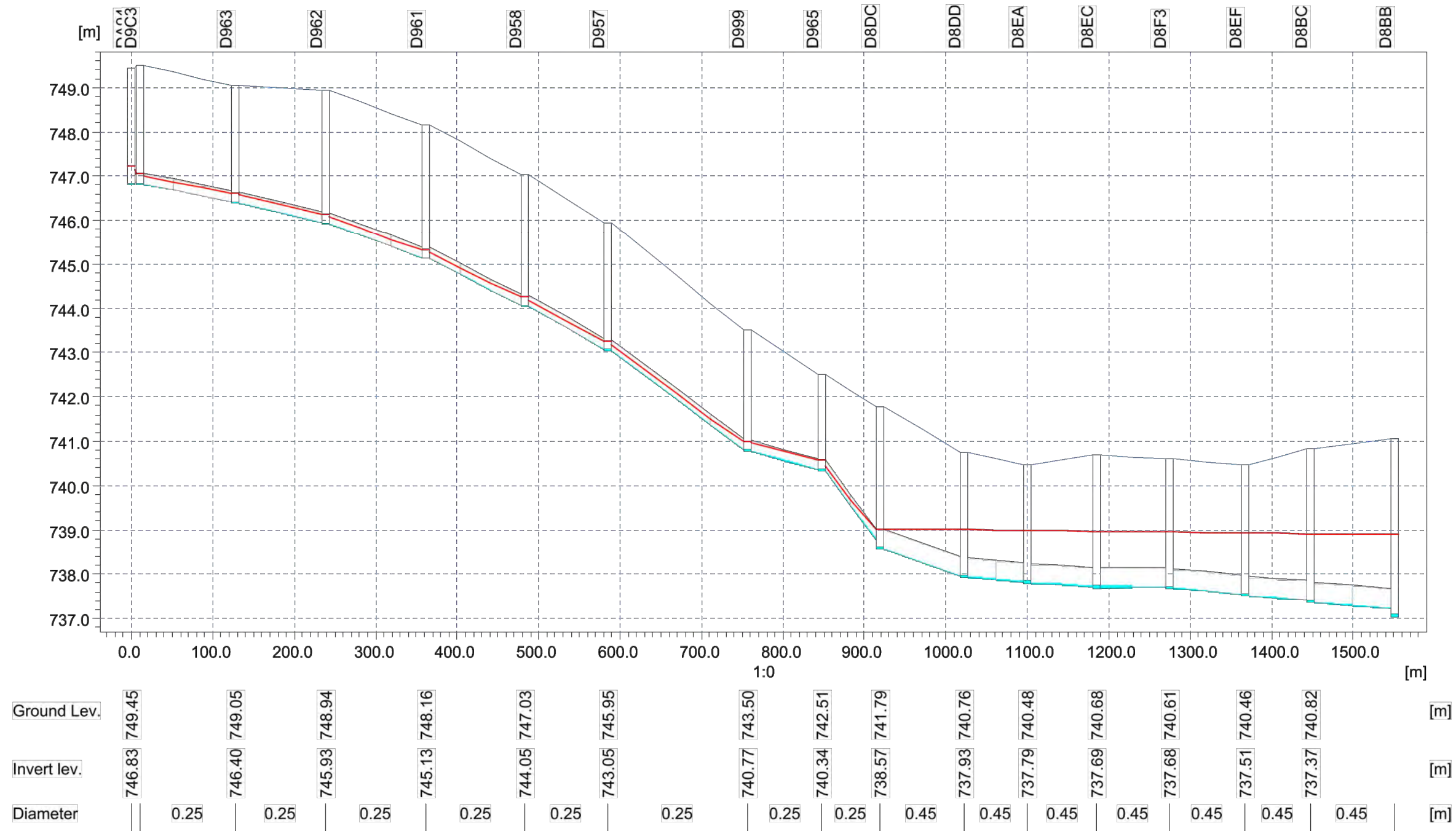
Maximum HGL Profile - LP #1 - Existing System Plus July 6 2013 Thunderstorm Scenario - 3-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF



**TOWN OF REDCLIFF**  
**SANITARY STUDY**  
**JULY 6 2013 THUNDERSTORM**  
**MAXIMUM HGL PROFILE - LP #1**  
**EXISTING TRUNK SEWER**

FIGURE 5.10.2

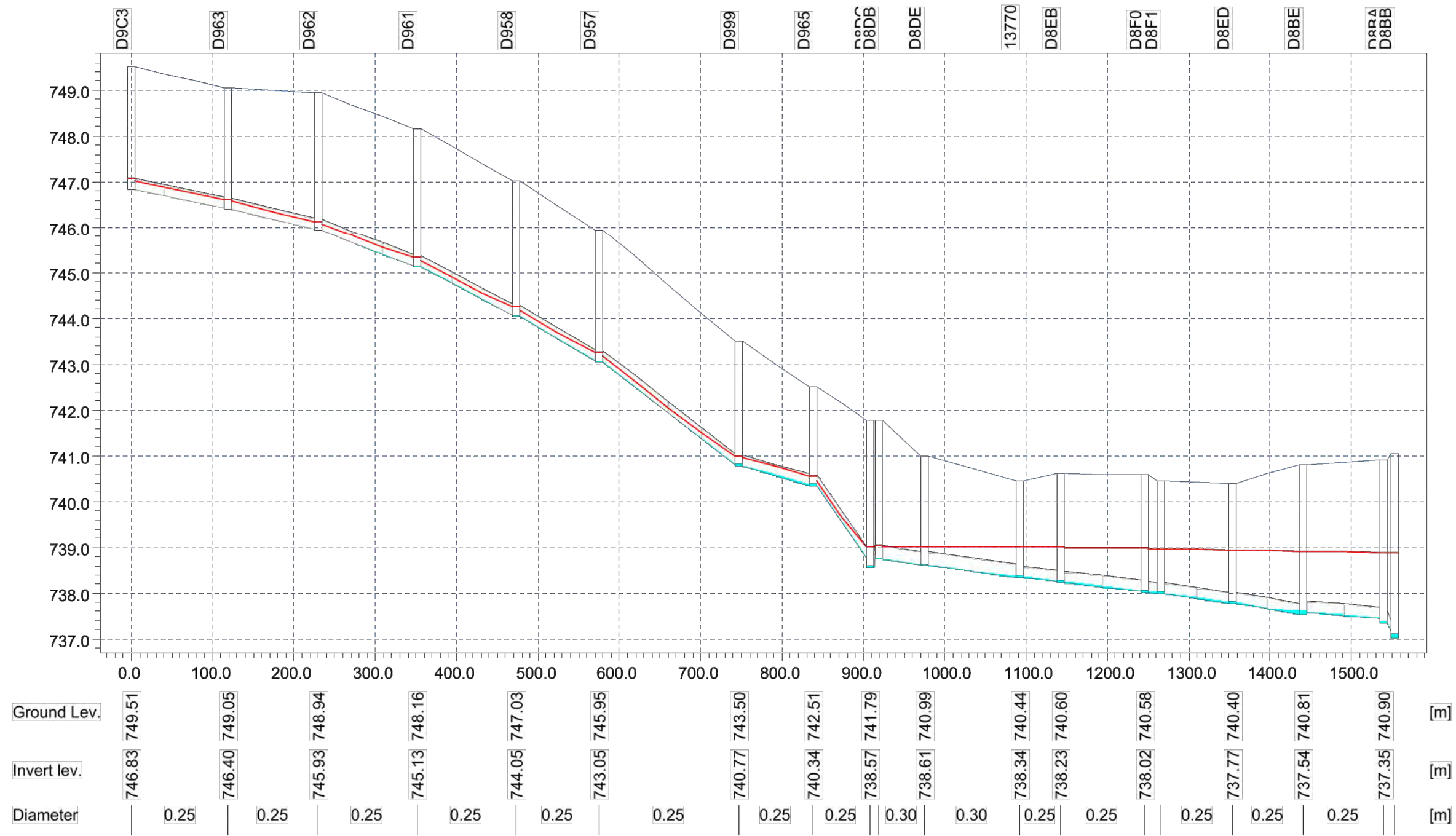
Maximum HGL Profile – LP #2A – Existing System Plus July 6 2013 Thunderstorm Scenario - 3-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF



TOWN OF REDCLIFF  
SANITARY H STUDY  
JULY 6 2013 THUNDERSTORM  
MAXIMUM HGL PROFILE - LP #2A  
EXISTING TRUNK SEWER

FIGURE 5.10.3

Maximum HGL Profile – LP #2B – Existing System Plus July 6 2013 Thunderstorm Scenario - 3-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF

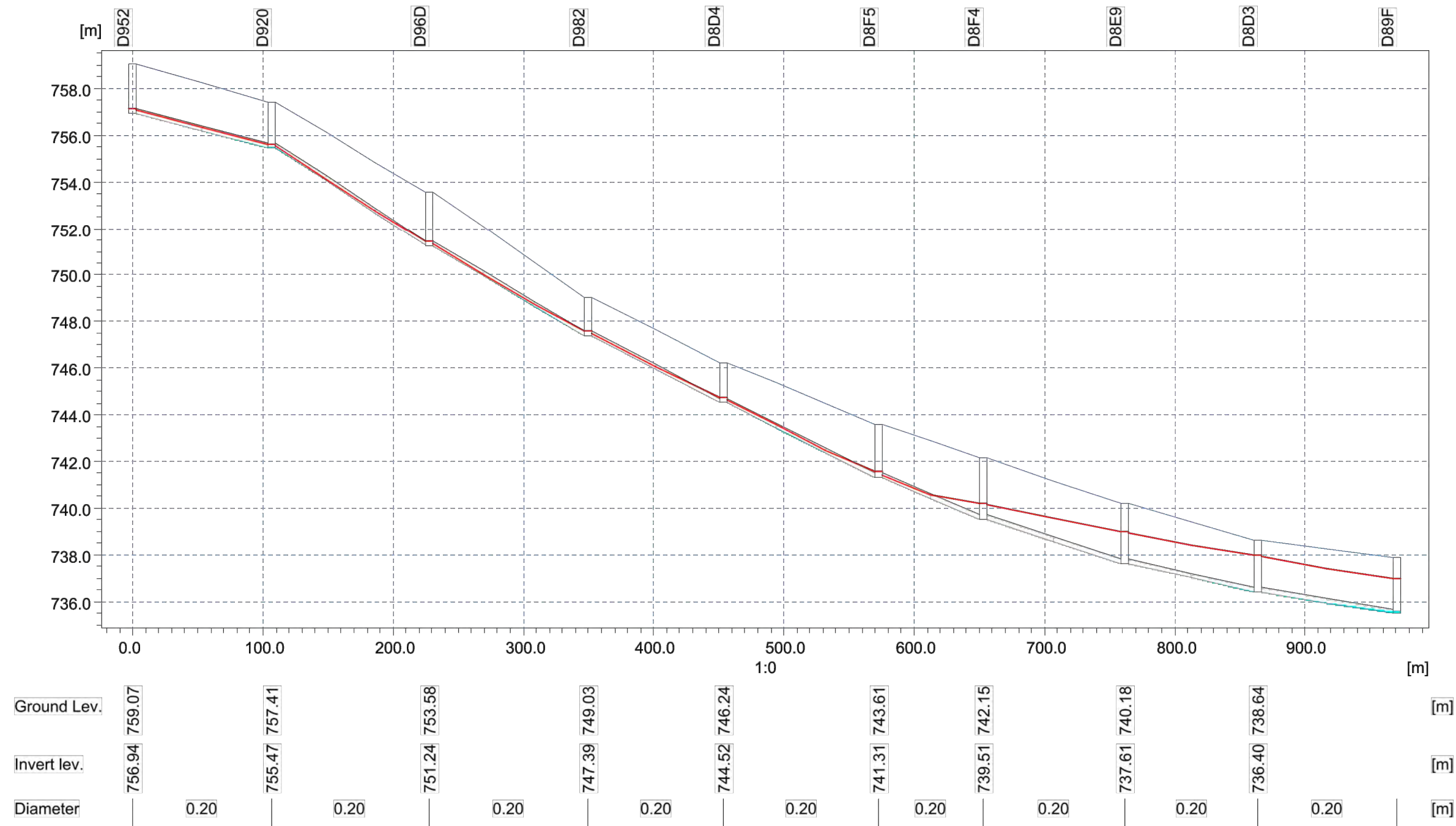


**TOWN OF REDCLIFF**  
**SANITARY STUDY**  
**JULY 6 2013 THUNDERSTORM**  
**MAXIMUM HGL PROFILE - LP #2B**  
**EXISTING TRUNK SEWER**



FIGURE 5.10.4

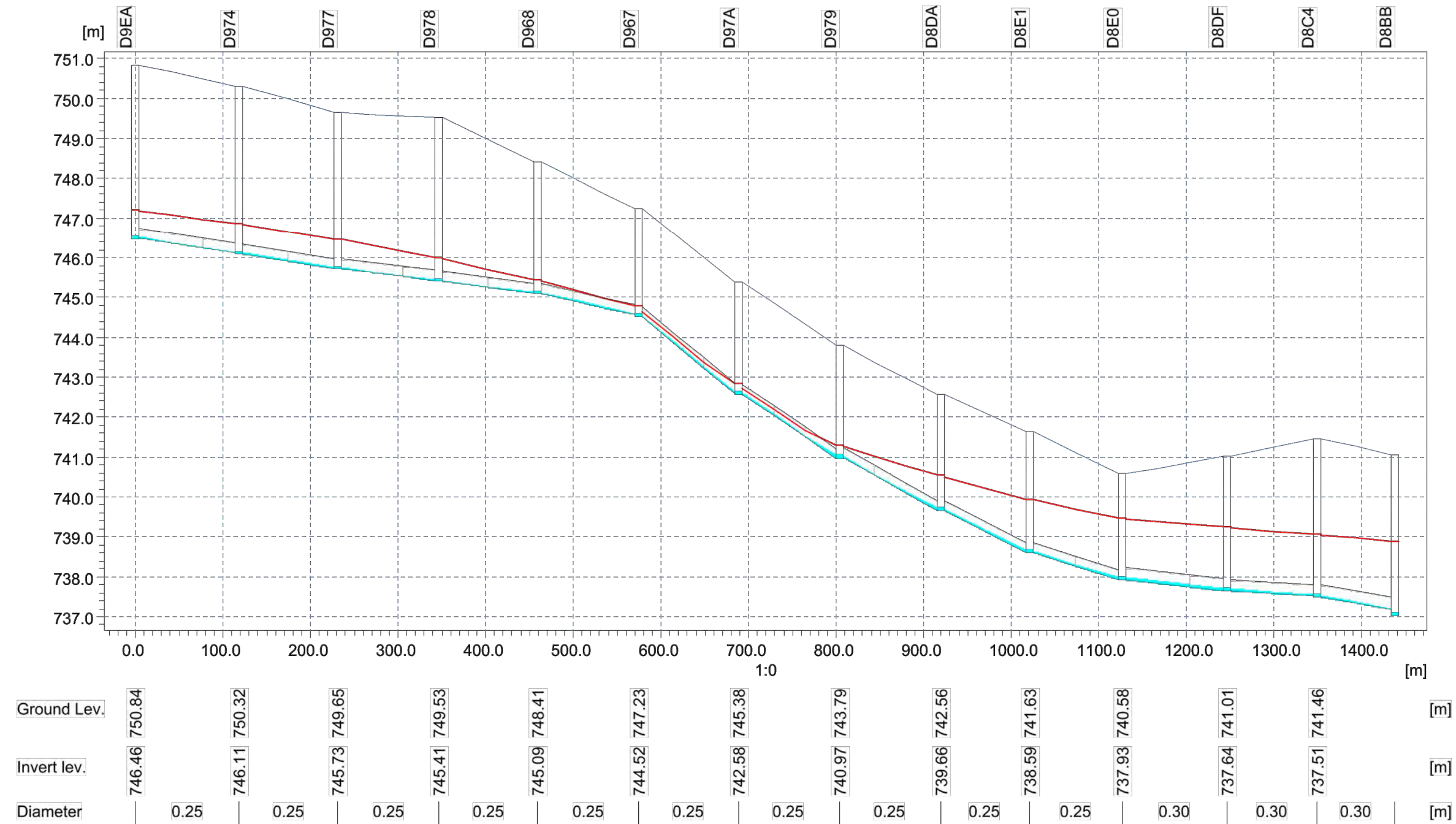
Maximum HGL Profile – LP #3 – Existing System Plus July 6 2013 Thunderstorm Scenario - 3-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**JULY 6 2013 THUNDERSTORM**  
**MAXIMUM HGL PROFILE - LP #3**  
**EXISTING TRUNK SEWER**

FIGURE 5.10.5

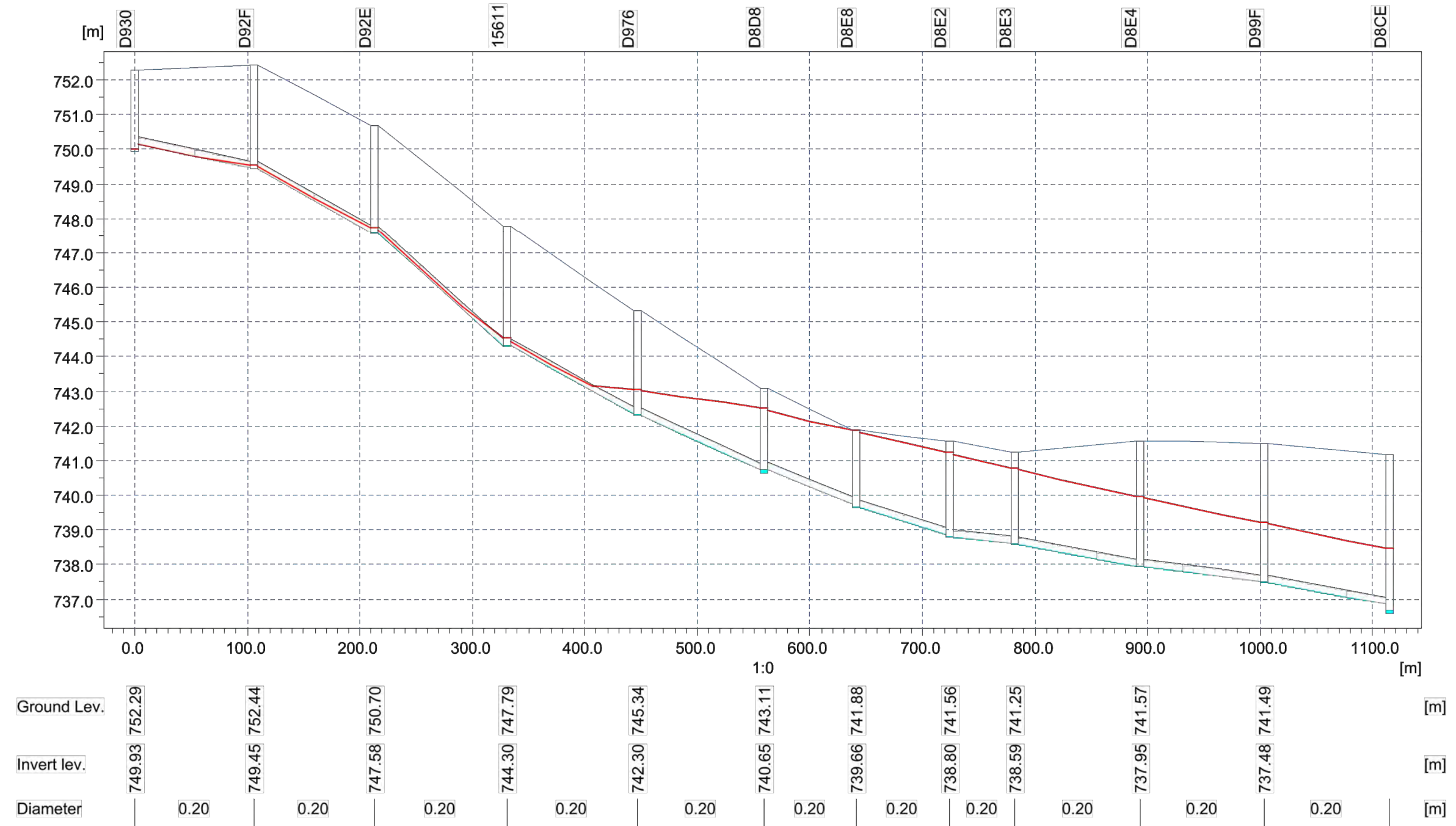
Maximum HGL Profile – LP #4 – Existing System Plus July 6 2013 Thunderstorm Scenario - 3-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**JULY 6 2013 THUNDERSTORM**  
**MAXIMUM HGL PROFILE - LP #4**  
**EXISTING TRUNK SEWER**

FIGURE 5.10.6

Maximum HGL Profile – LP #5 – Existing System Plus July 6 2013 Thunderstorm Scenario - 3-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF



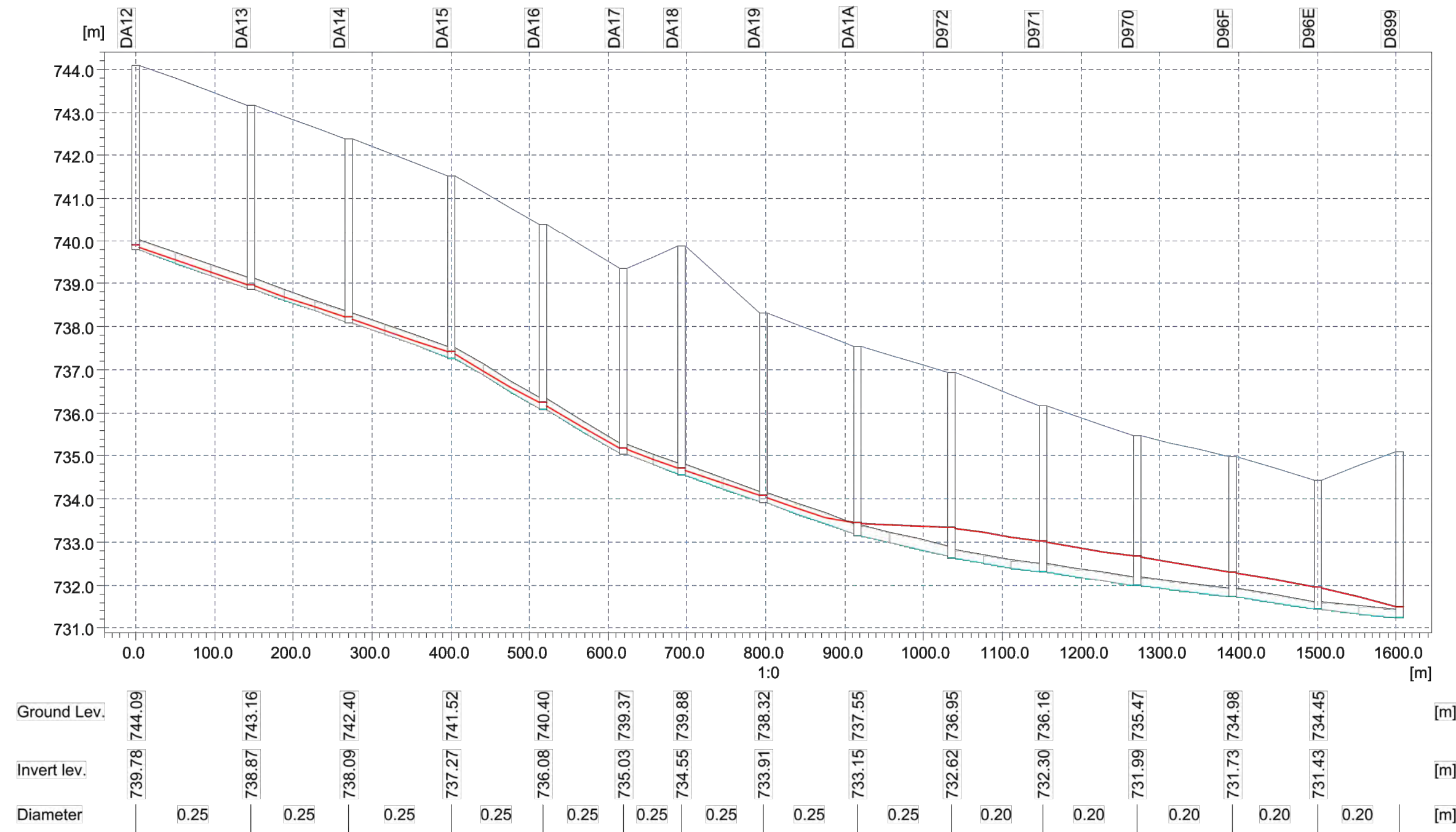
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**JULY 6 2013 THUNDERSTORM**  
**MAXIMUM HGL PROFILE - LP #5**  
**EXISTING TRUNK SEWER**



RAFAL JADZINSKI Apr. 7, 15 10:55:17 AM N: 26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\IPS\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES - JULY 6 2013 THUNDERSTORM.DWG

FIGURE 5.10.7

Maximum HGL Profile – LP #6 – Existing System Plus July 6 2013 Thunderstorm Scenario - 3-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF



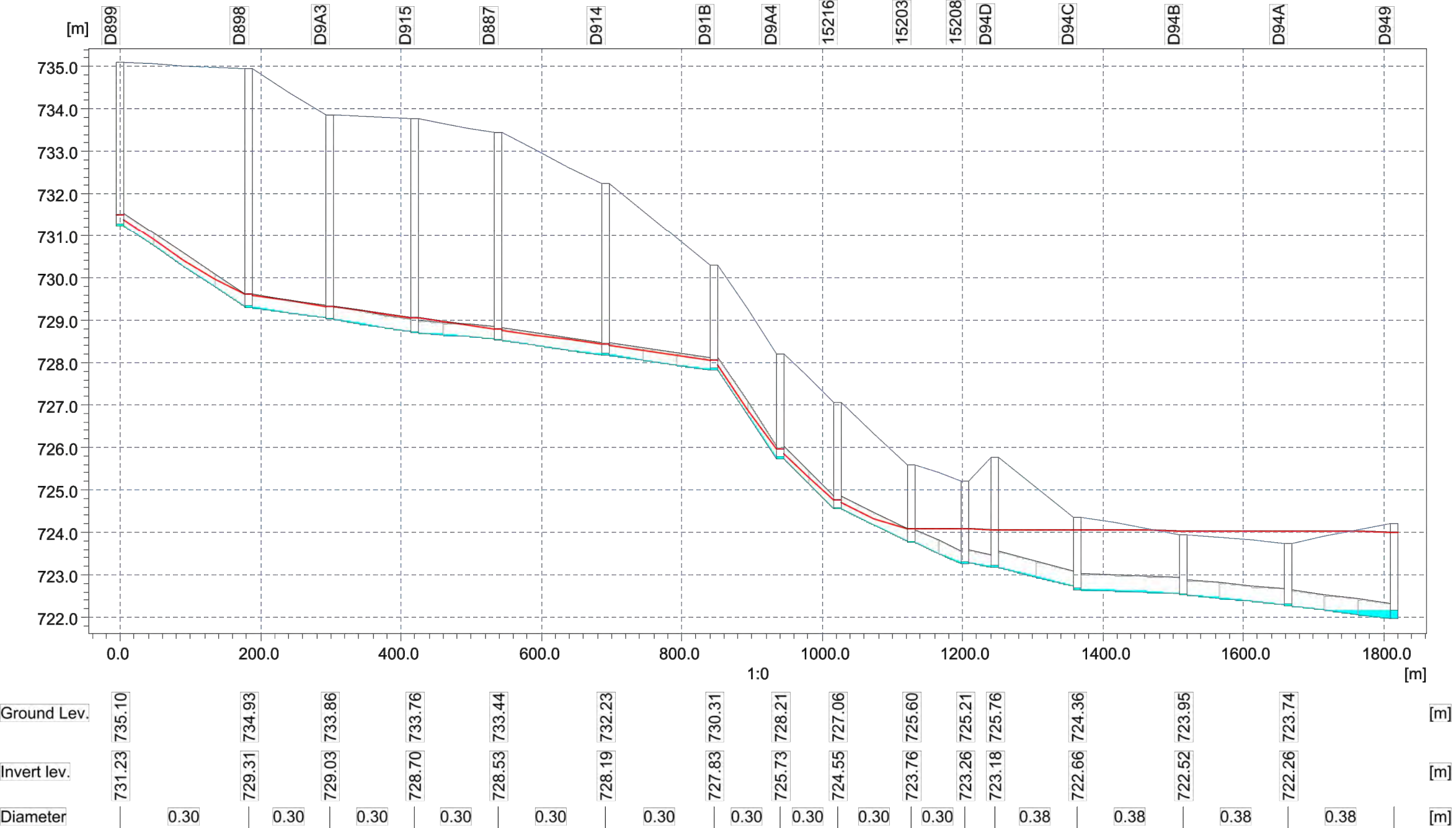
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**JULY 6 2013 THUNDERSTORM**  
**MAXIMUM HGL PROFILE - LP #6**  
**EXISTING TRUNK SEWER**





FIGURE 5.10.8

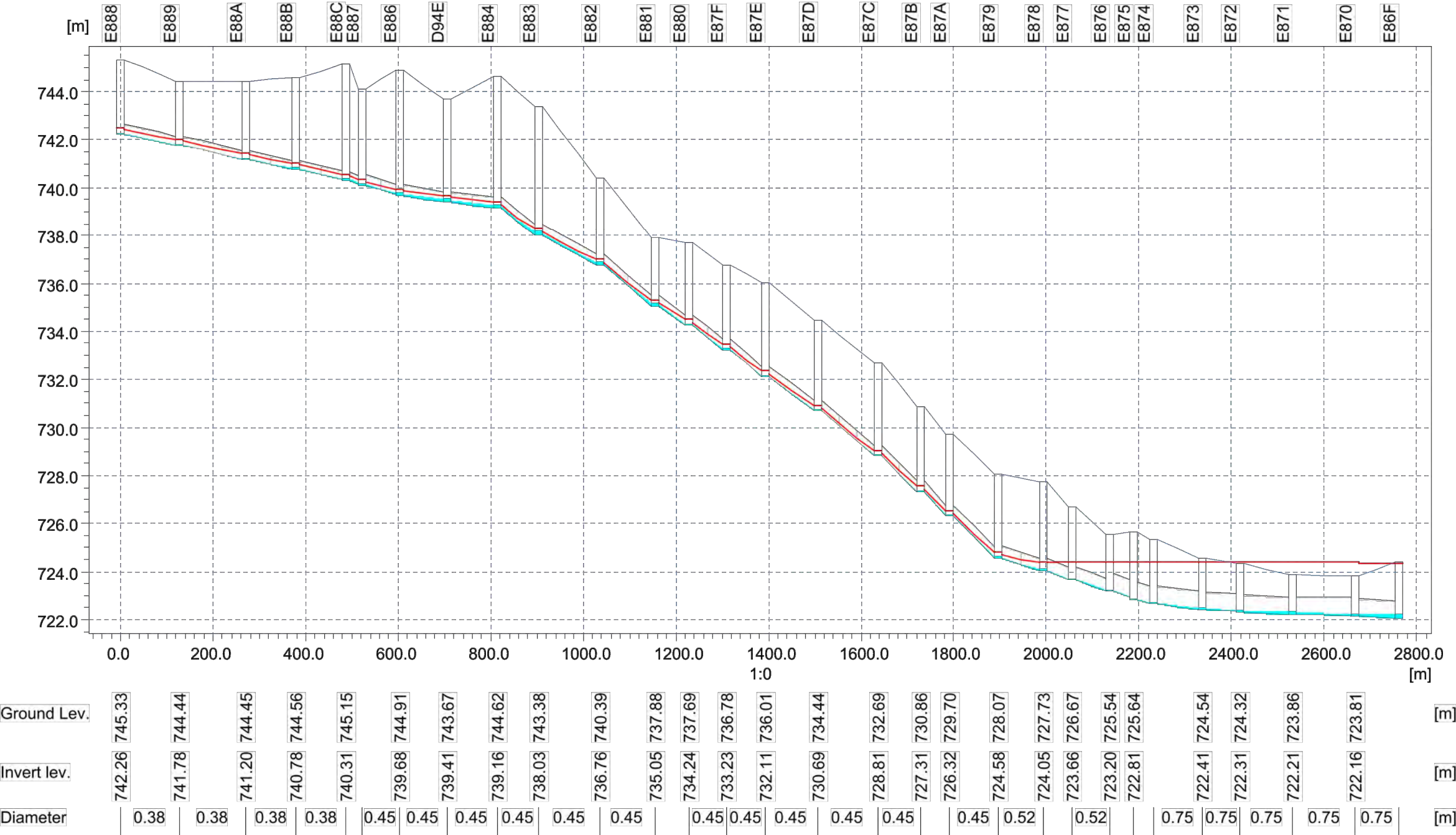
Maximum HGL Profile – LP #7 – Existing System Plus July 6 2013 Thunderstorm Scenario - 3-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**JULY 6 2013 THUNDERSTORM**  
**MAXIMUM HGL PROFILE - LP #7**  
**EXISTING TRUNK SEWER**

FIGURE 5.10.9

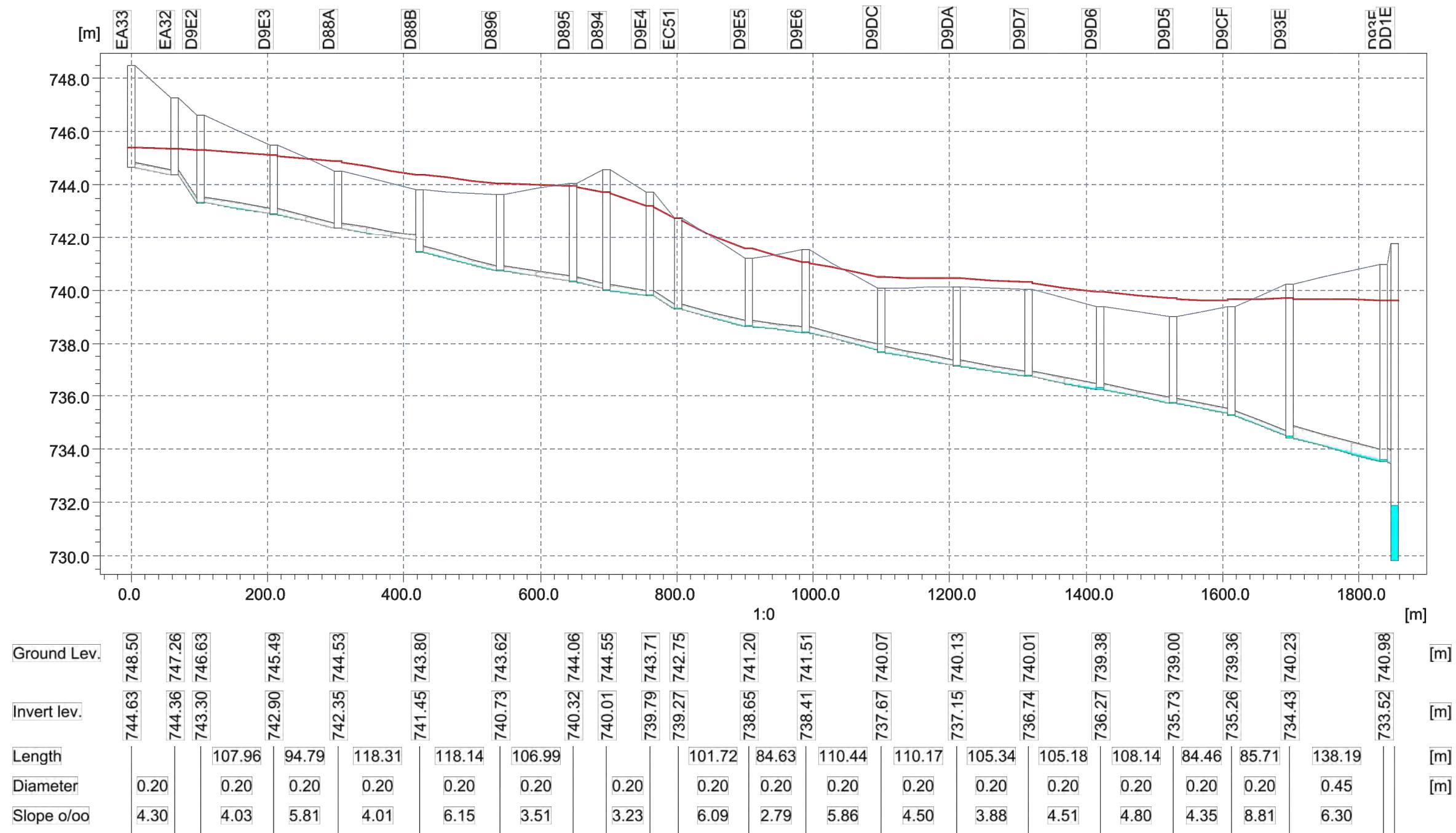
Maximum HGL Profile - LP #8 - Existing System Plus July 6 2013 Thunderstorm Scenario - 12-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**JULY 6 2013 THUNDERSTORM**  
**MAXIMUM HGL PROFILE - LP #8**  
**EXISTING TRUNK SEWER**

FIGURE 5.10.10

Maximum HGL Profile – LP #9 – Existing System Plus July 6 2013 Thunderstorm Scenario - 3-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF

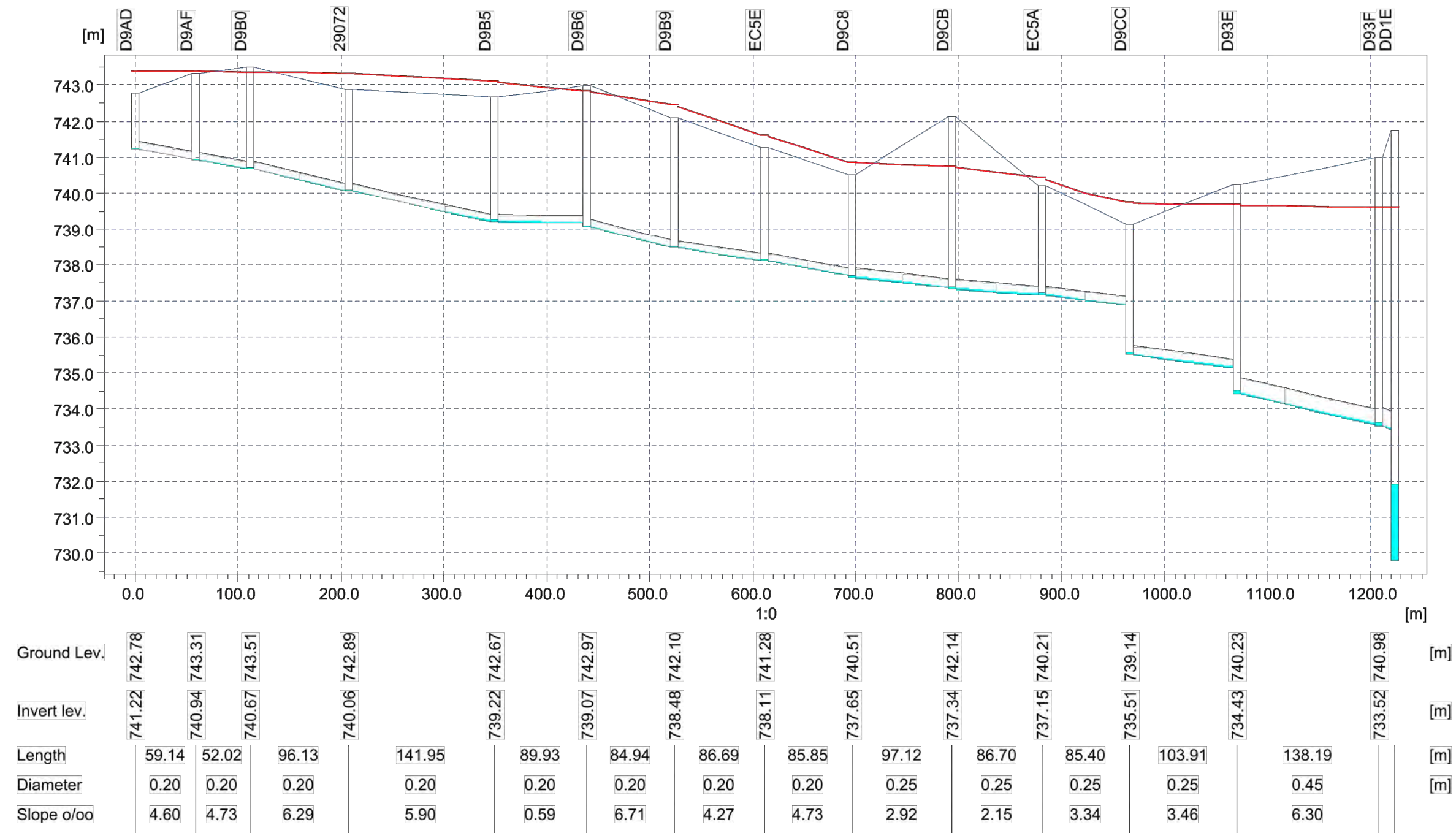


TOWN OF REDCLIFF  
SANITARY I-I STUDY  
JULY 6 2013 THUNDERSTORM  
MAXIMUM HGL PROFILE - LP #9  
EXISTING TRUNK SEWER



FIGURE 5.10.11

Maximum HGL Profile – LP #10 – Existing System Plus July 6 2013 Thunderstorm Scenario - 3-7-2013 00:00:00 HD MIN-Band July 6 2013 Thunderstorm.PRF

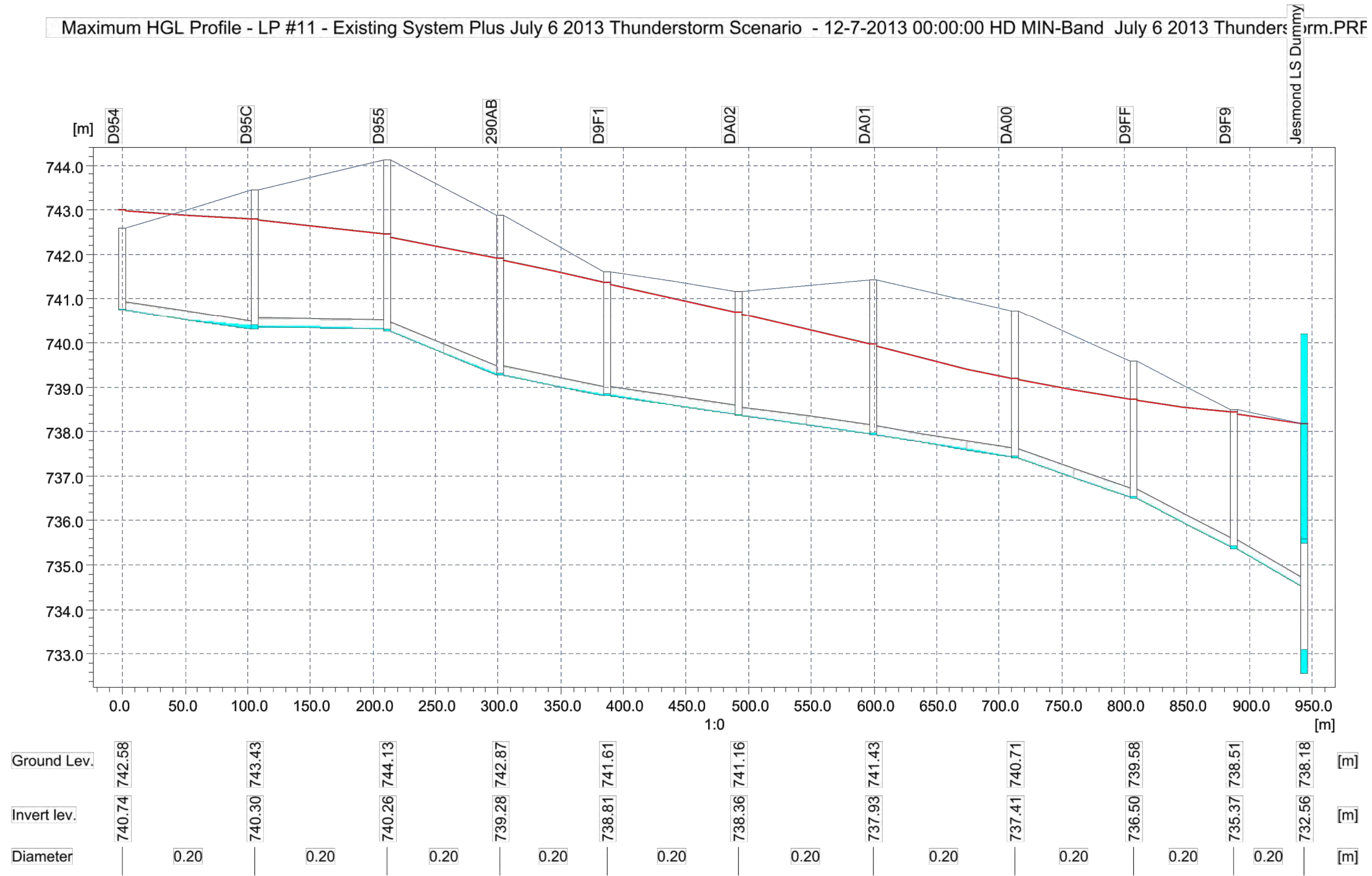


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**JULY 6 2013 THUNDERSTORM**  
**MAXIMUM HGL PROFILE - LP #10**  
**EXISTING TRUNK SEWER**



FIGURE 5.10.12

RAFAL JADZINSKI Apr. 7, 15 10:55:24 AM N: \\26000\26031\_REDCLIFF\_SANITARY\J\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\LP5\EX\_ASSESSMENT\26031\_MAX\_HGL\_PROFILES - JULY 6 2013\_THUNDERSTORM.DWG



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**JULY 6 2013 THUNDERSTORM**  
**MAXIMUM HGL PROFILE - LP #11**  
**EXISTING TRUNK SEWER**



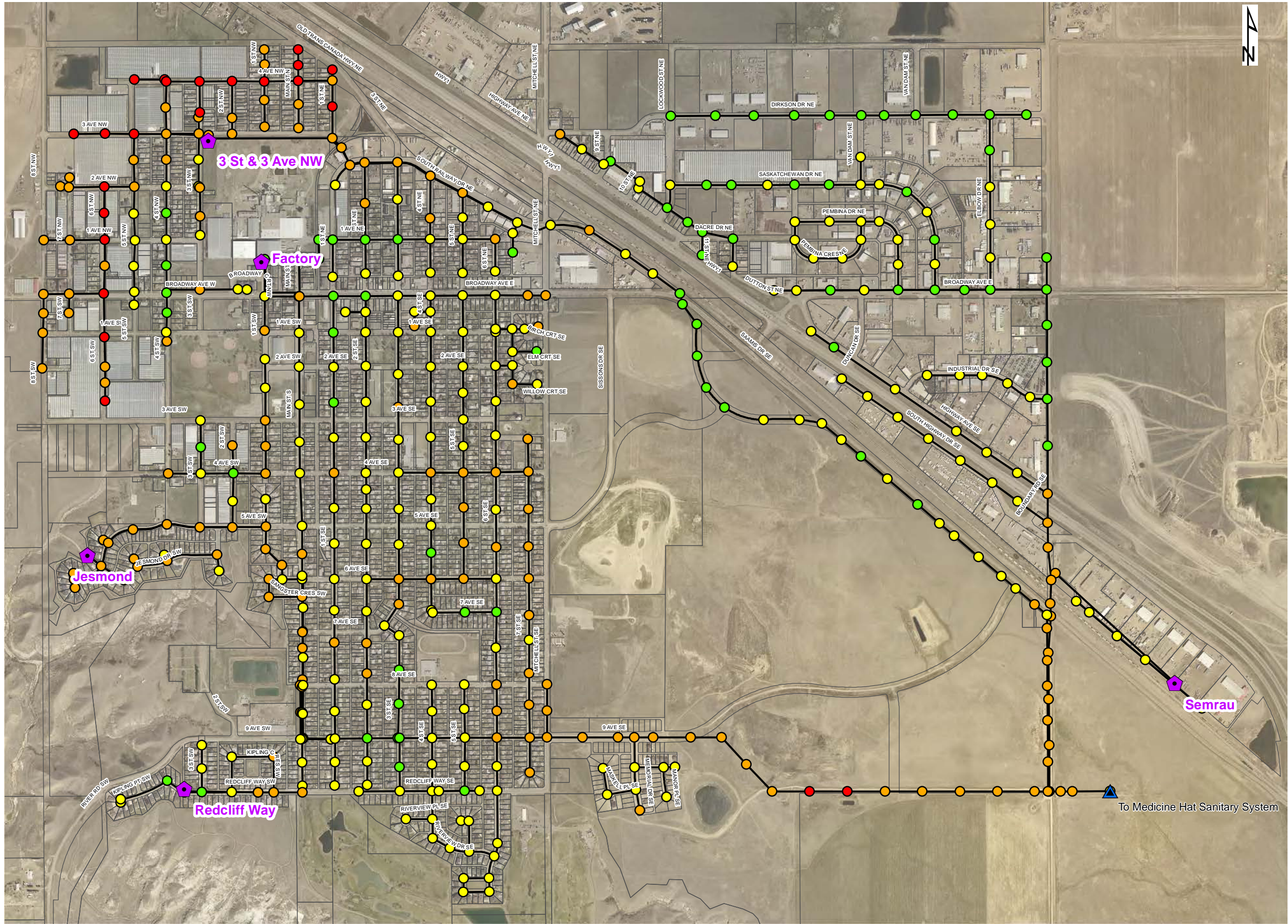
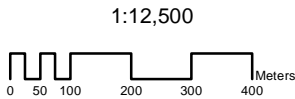


FIGURE 5.11

Legend

- Less Than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and -0.50m
- Greater Than 0.00m
- Sanitary Trunk
- ⬠ Lift Station



TOWN OF REDCLIFF  
SANITARY I-I STUDY

PEAK HGL RELATIVE TO GROUND  
EXISTING SYSTEM WITH  
MEDICINE HAT SEWER UPSIZED  
PLUS 50YR 24HR HUFF Q4 STORM





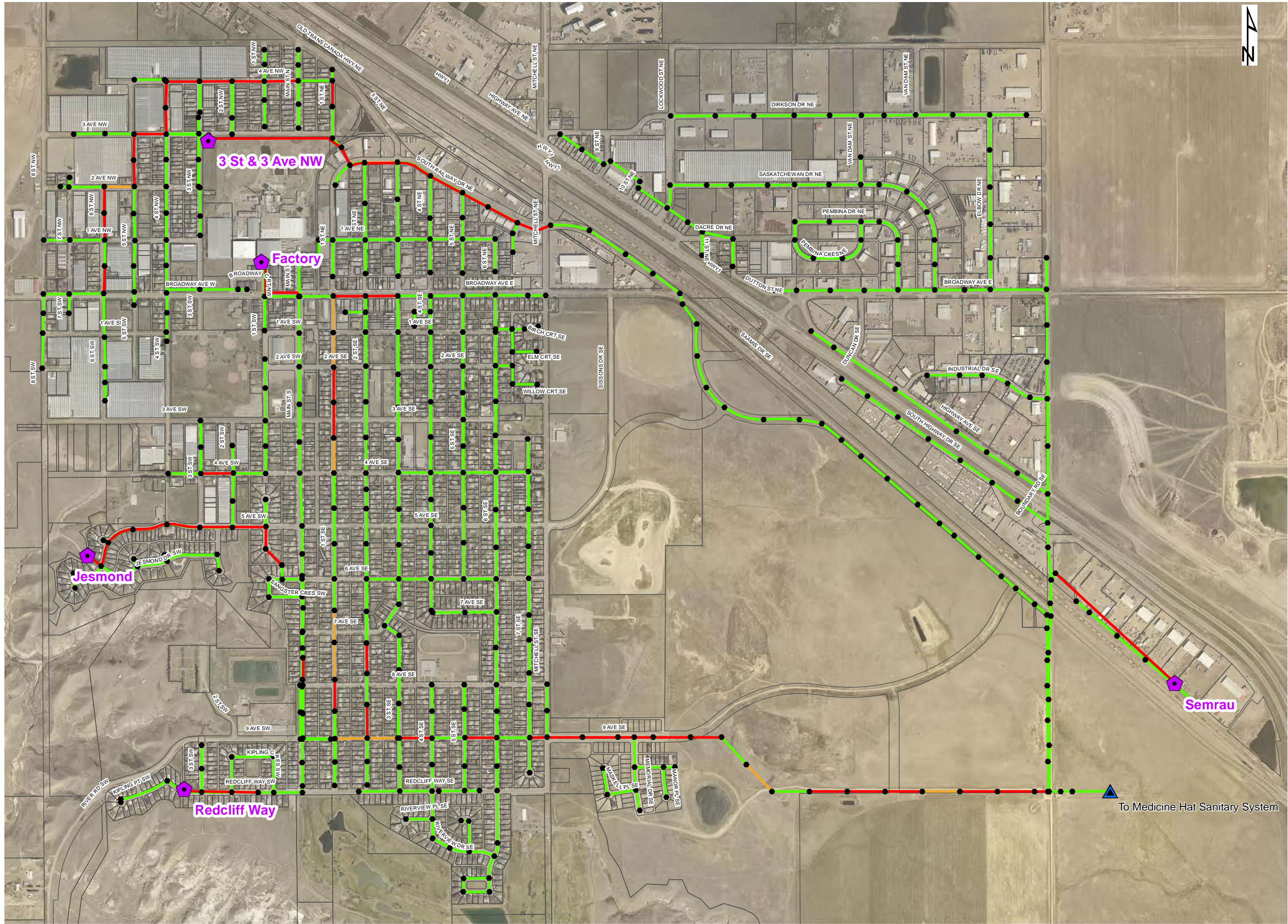
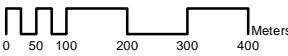


FIGURE 5.12

### Legend

- Greater Than 100%
- Between 86% and 100%
- Less Than 86%
- Lift Station

1:12,500



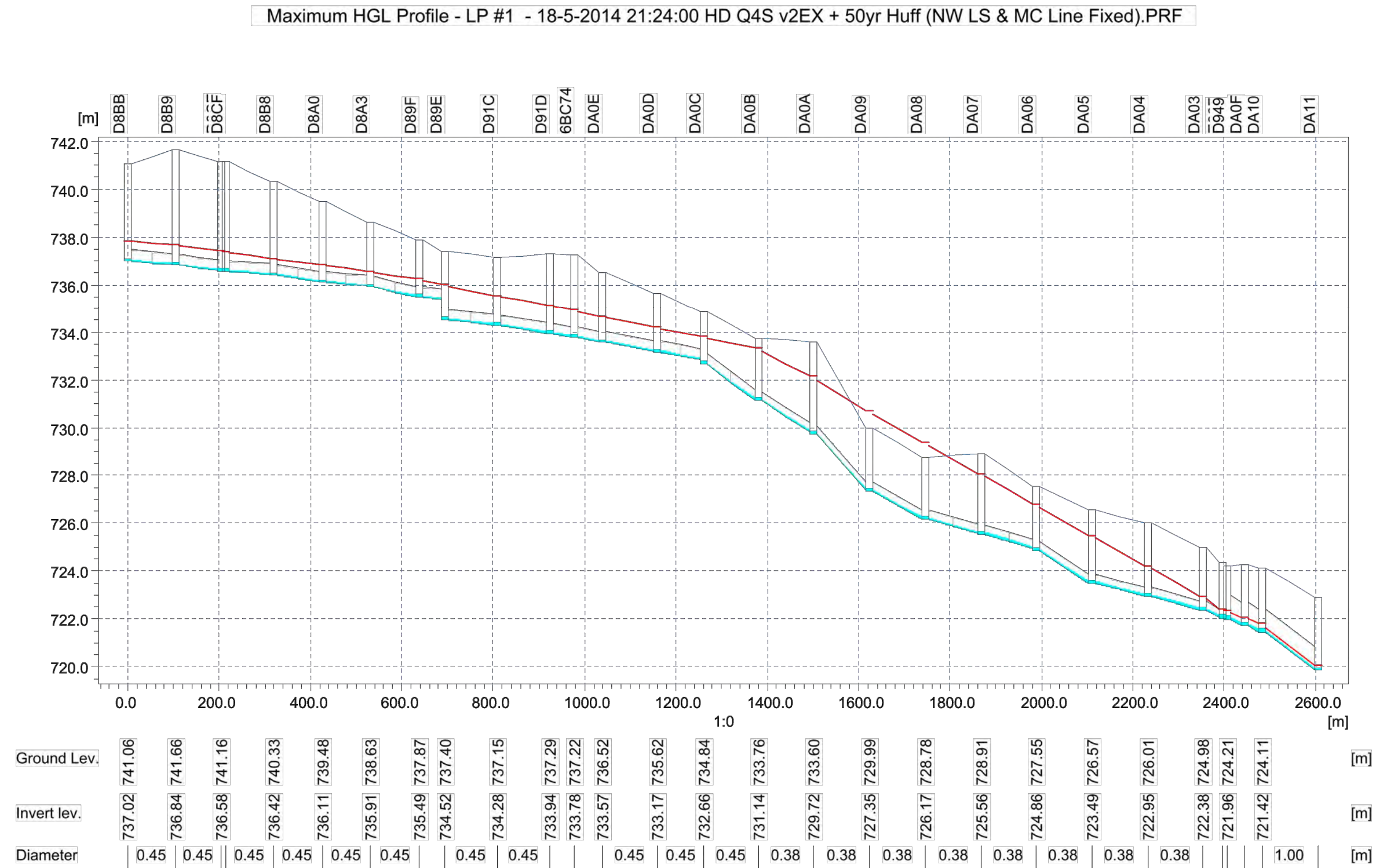
### TOWN OF REDCLIFF SANITARY I-I STUDY

PEAK DISCHARGE RELATIVE TO PIPE CAPACITY  
EXISTING SYSTEM WITH  
MEDICINE HAT SEWER UPSIZED  
PLUS 50YR 24HR HUFF Q4 STORM





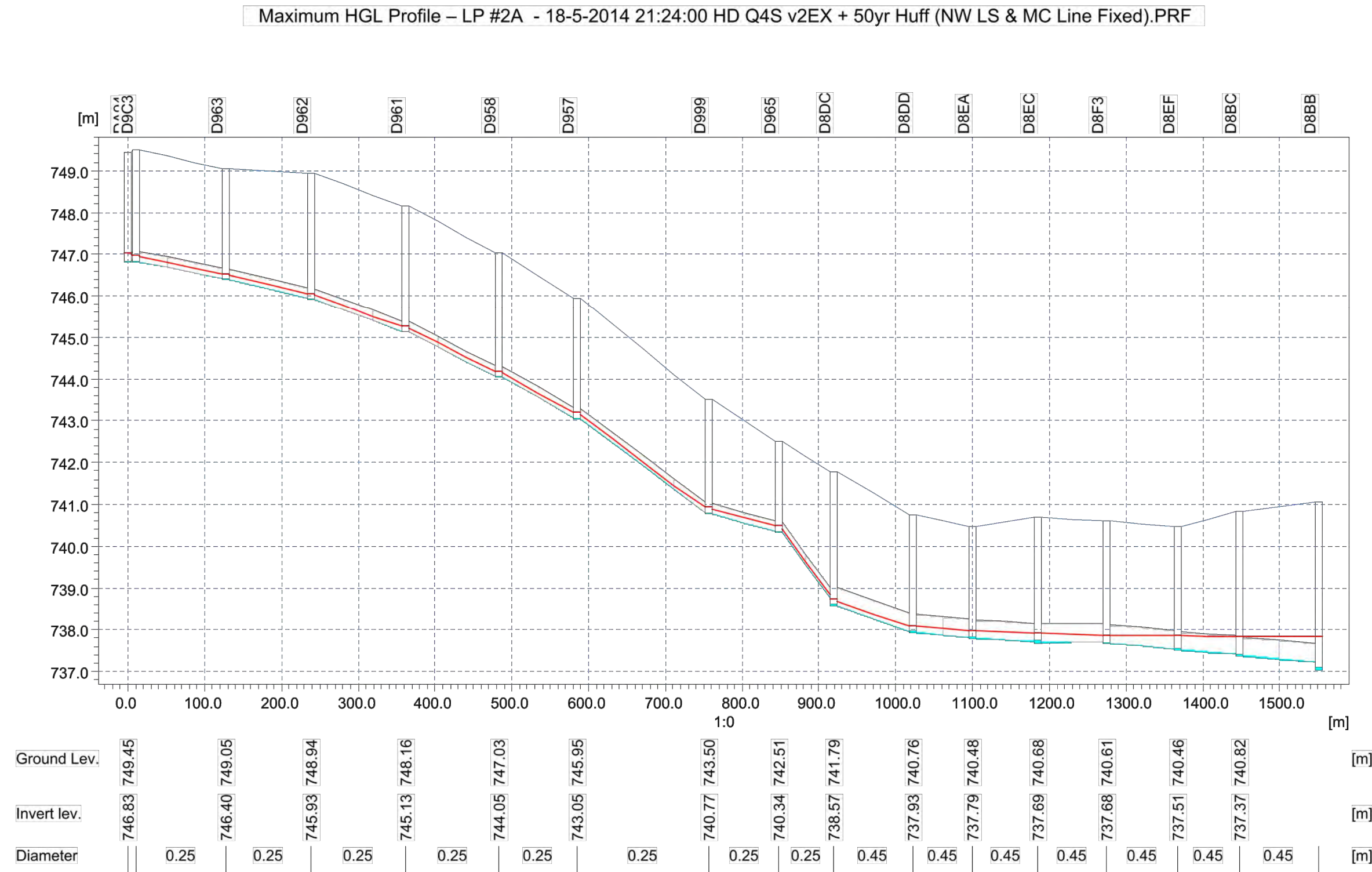
FIGURE 5.13.1



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #1**

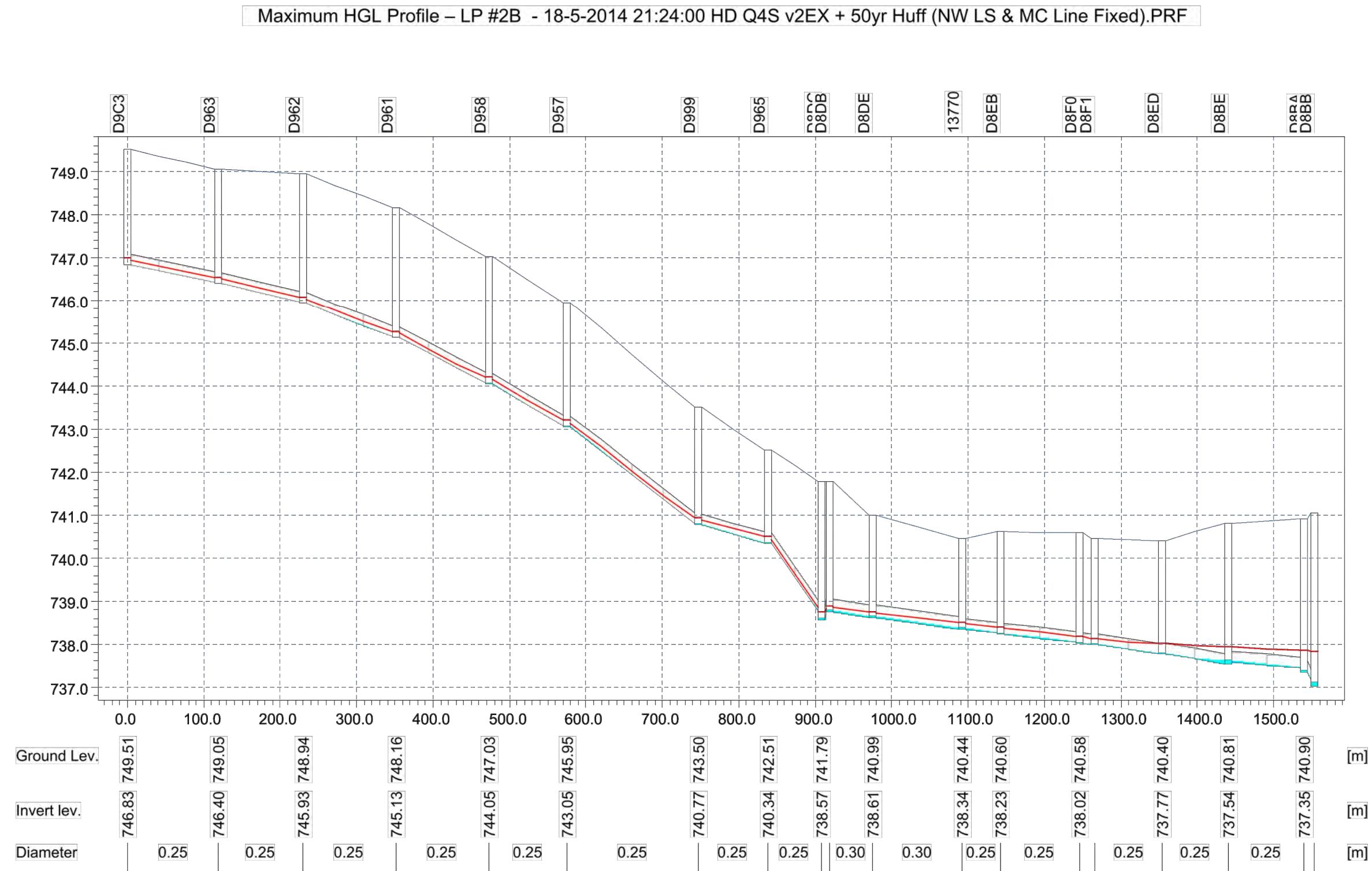


FIGURE 5.13.2



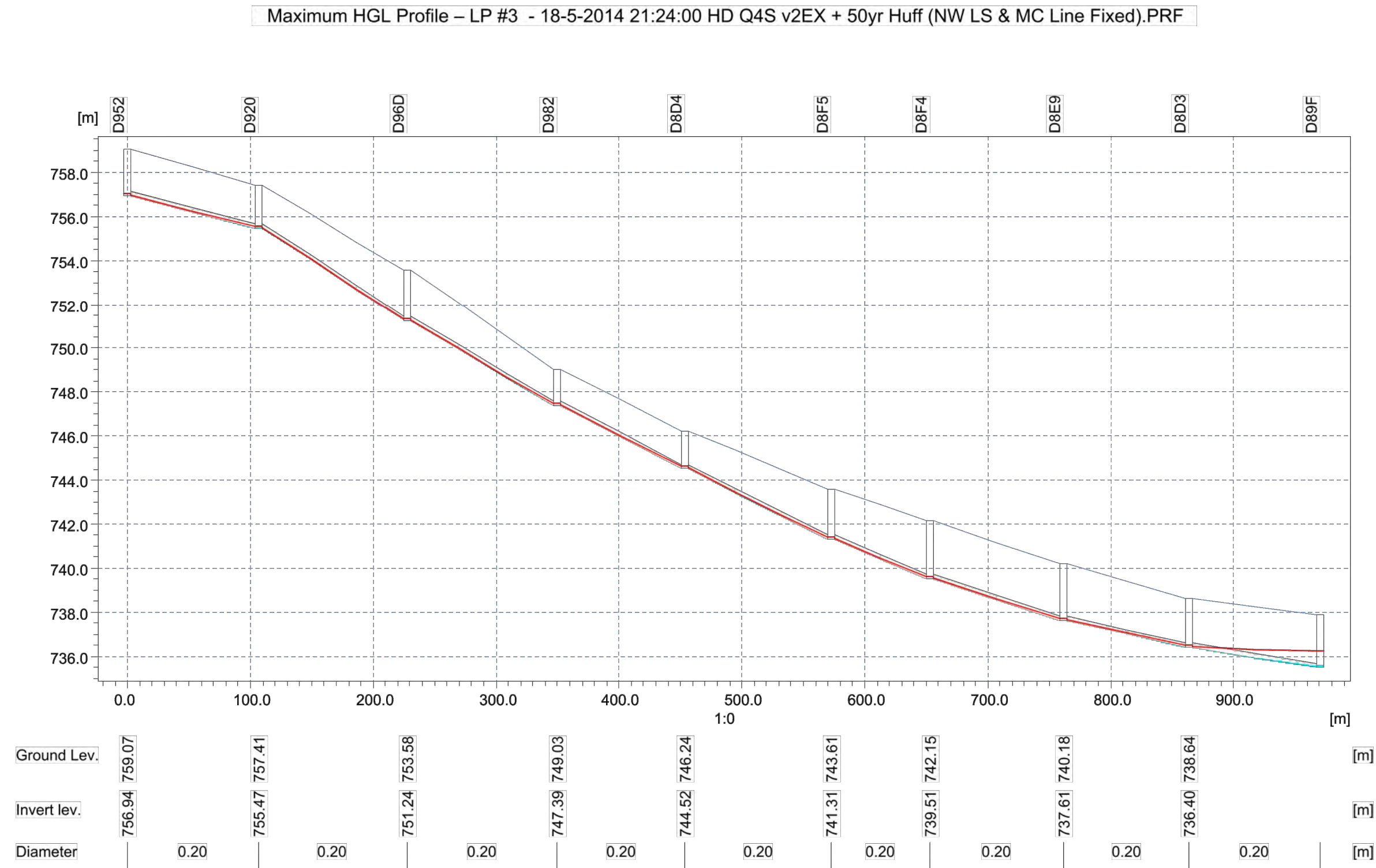
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #2A**

FIGURE 5.13.3



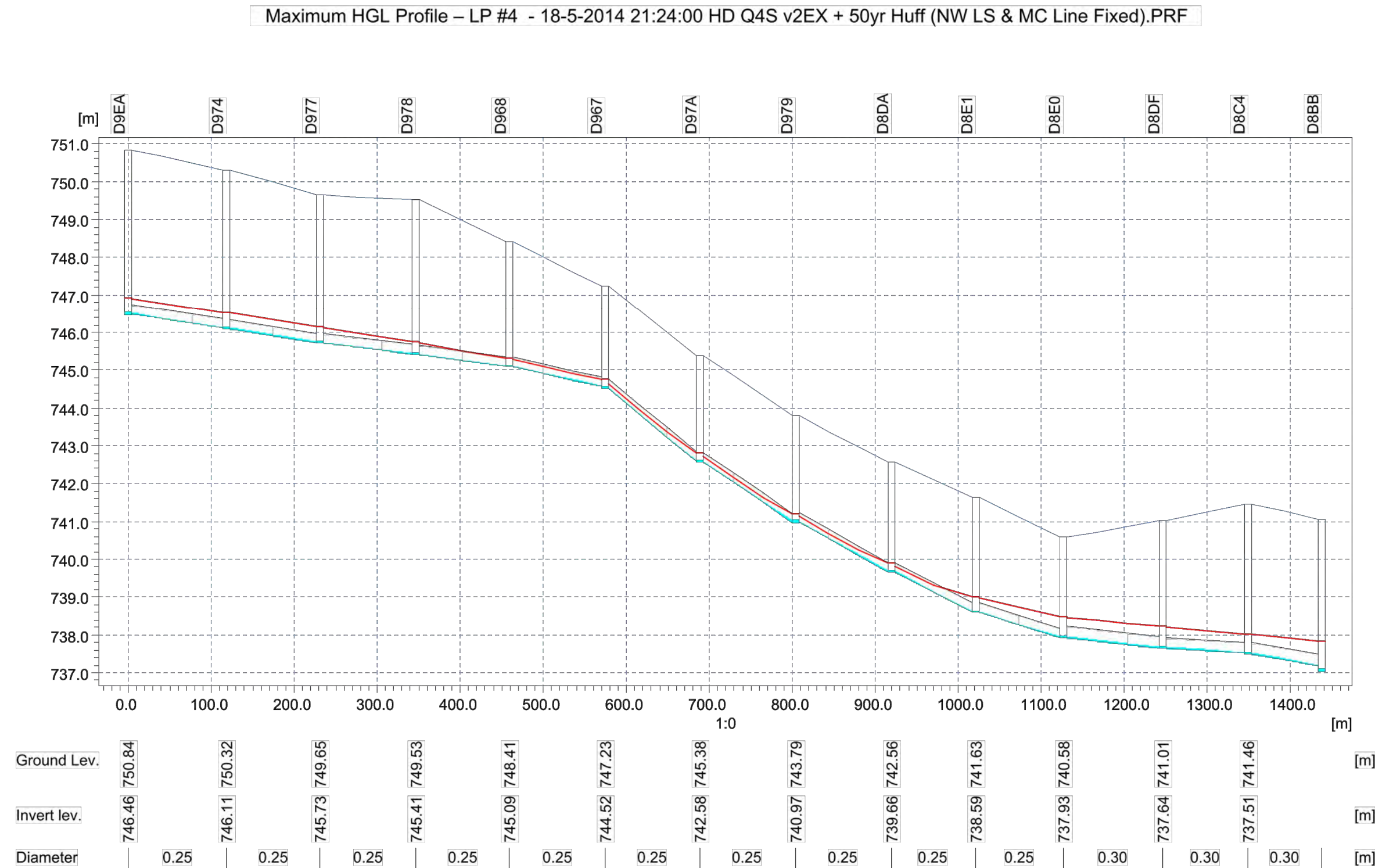
**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #2B**

FIGURE 5.13.4



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #3**

FIGURE 5.13.5

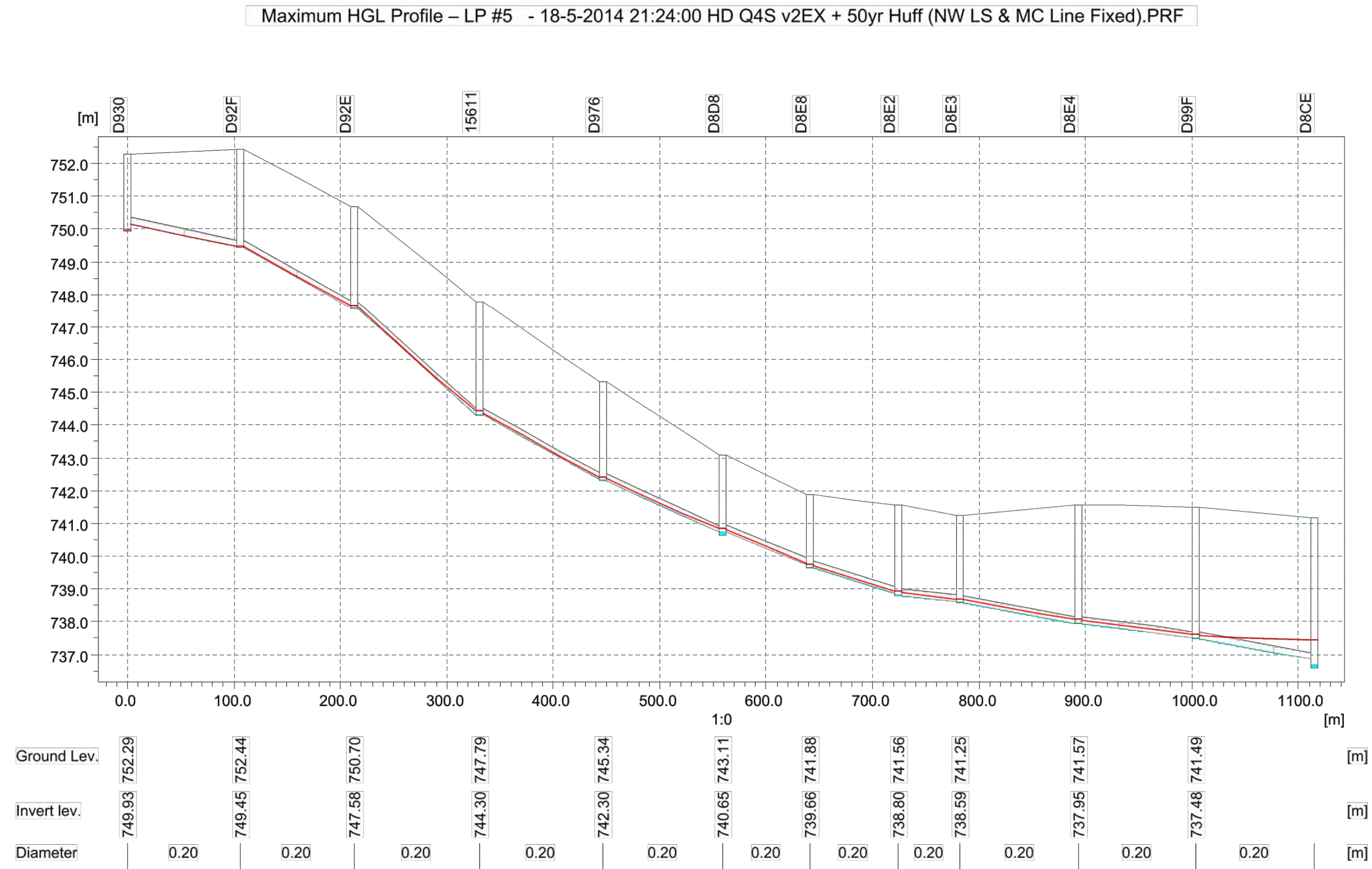


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #4**

RAFAL\_JADZINSKI Apr. 7, 15 10:56:45 AM N: \\26000\\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\\02\_CADD\\20\_DRAFTING\\201\_FIGURES\\LPS\\EX\_ASSESSMENT - (NW LS & MC SEWER FIXED)\\26031\_MAX HGL PROFILES - 50YR 24HR HUFF Q4 STORM (NW LS & MC LINE FIXED).PRF

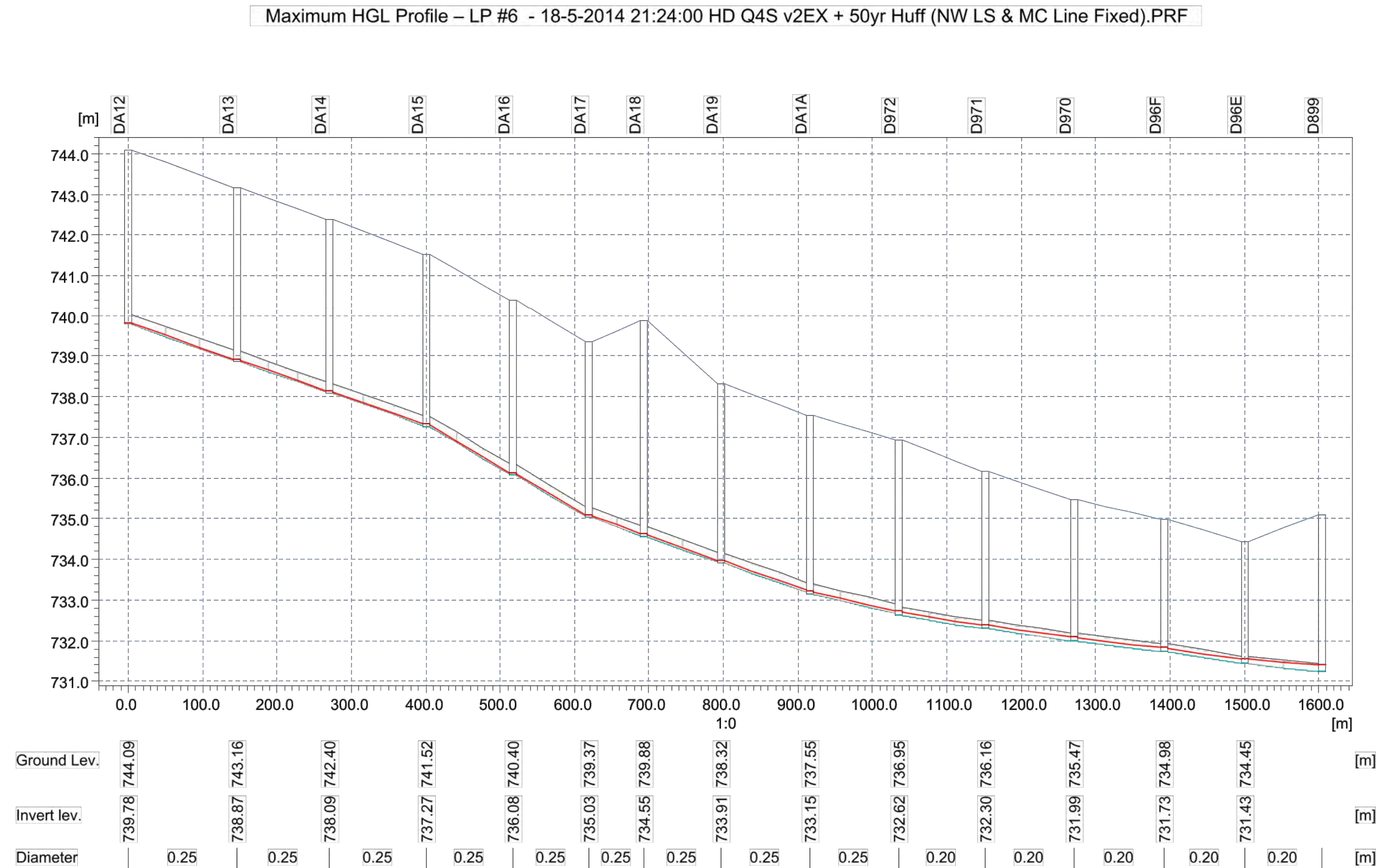


FIGURE 5.13.6



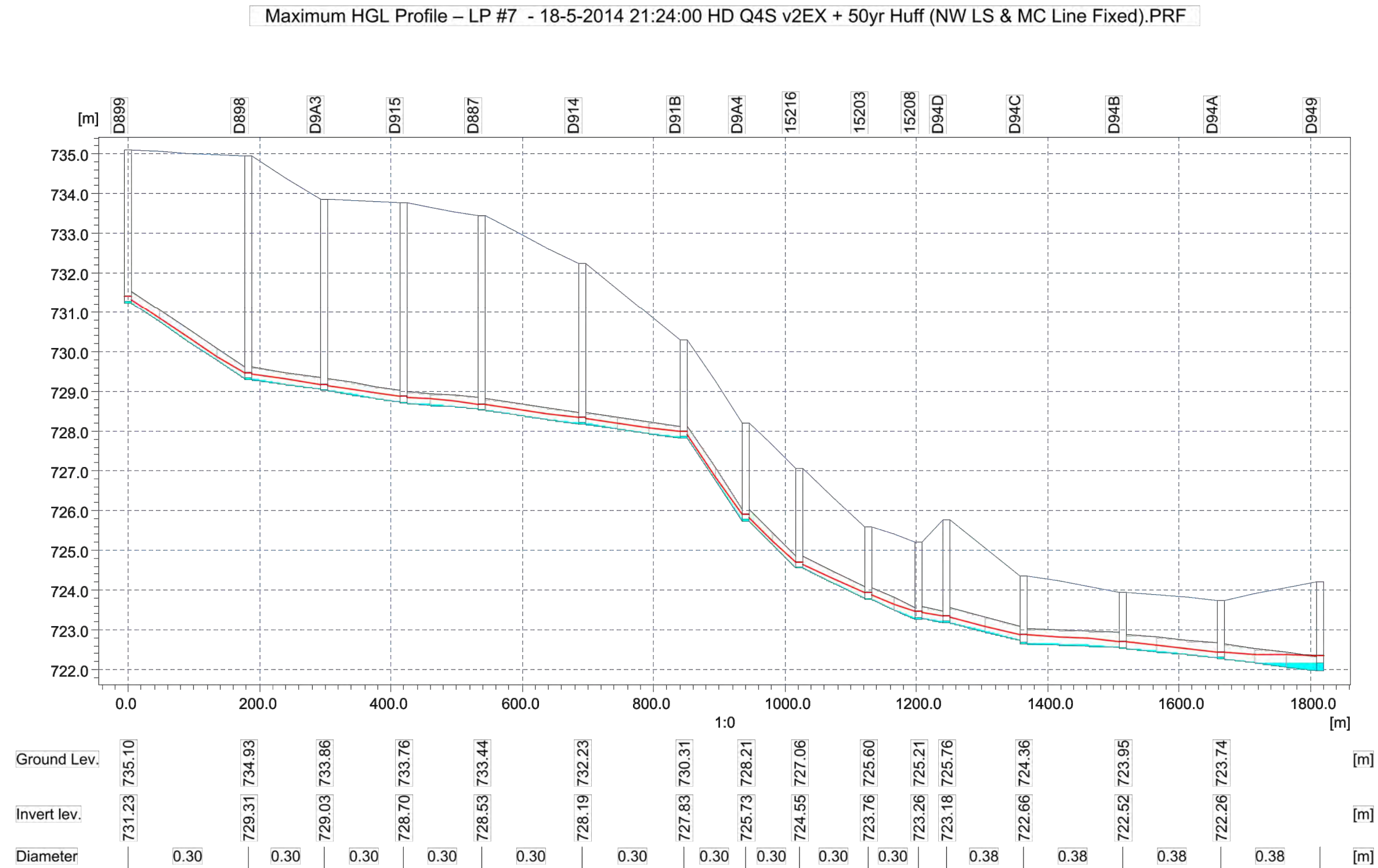
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #5**

FIGURE 5.13.7



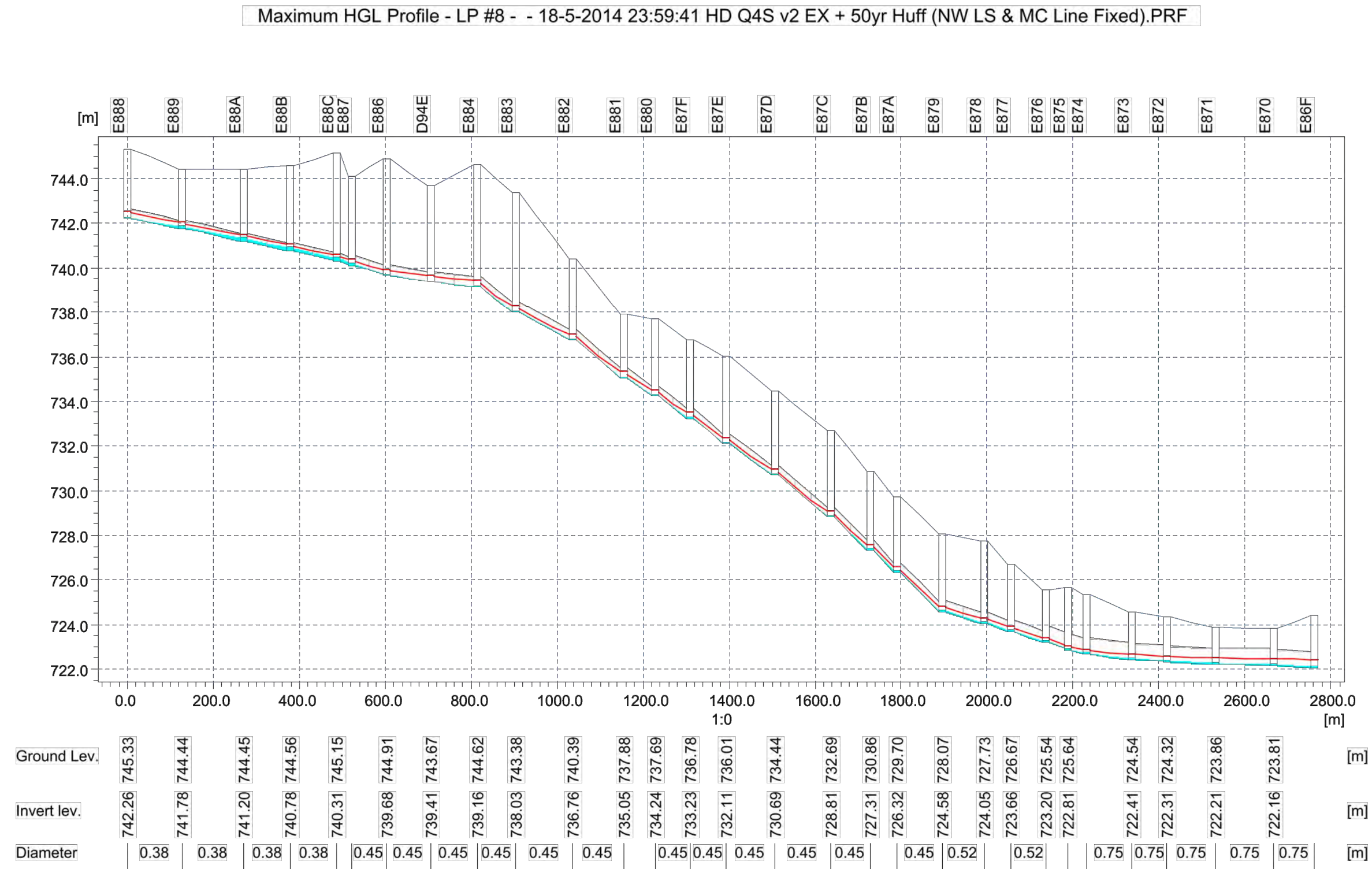
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #6**

FIGURE 5.13.8



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #7**

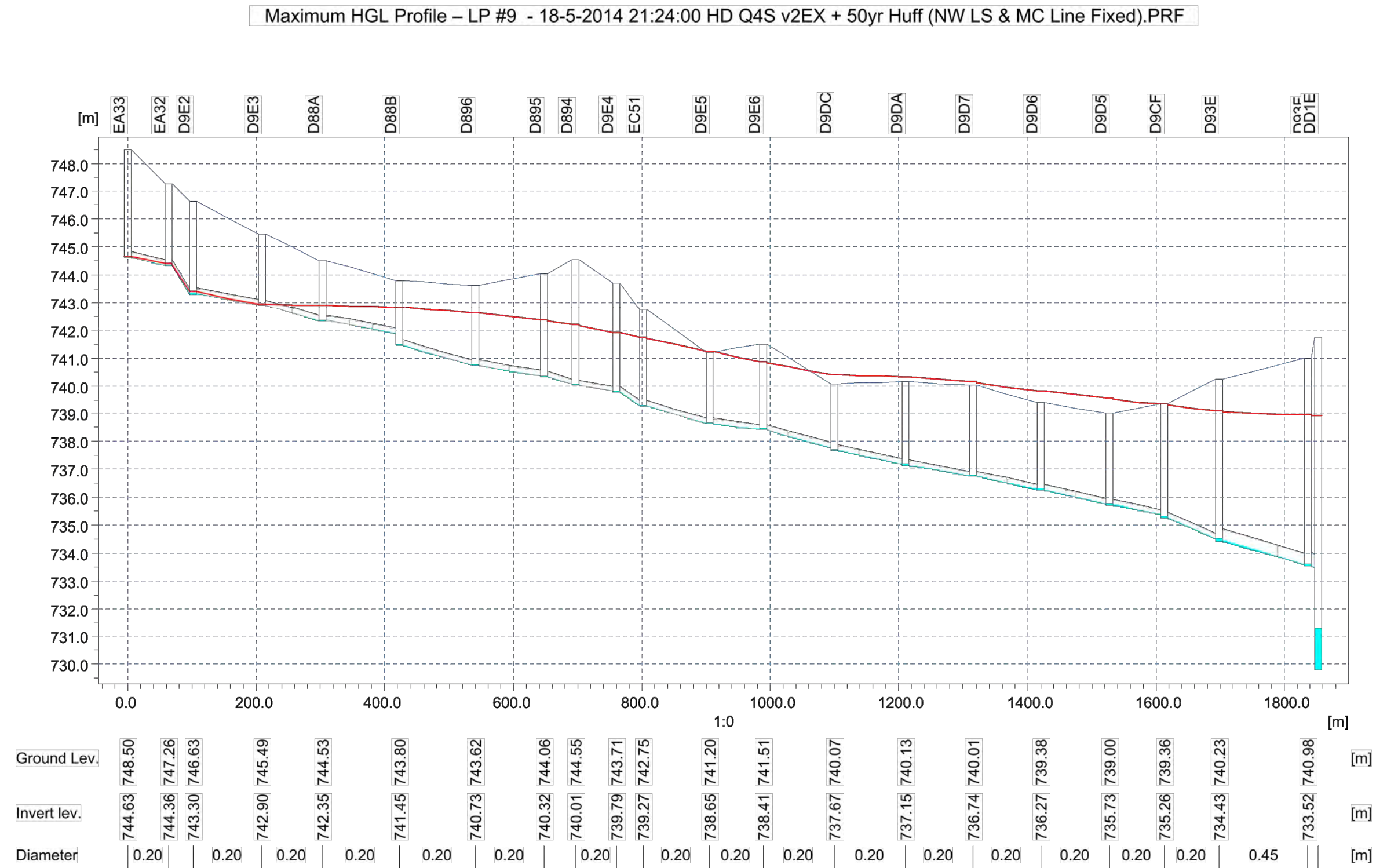
FIGURE 5.13.9



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #8**

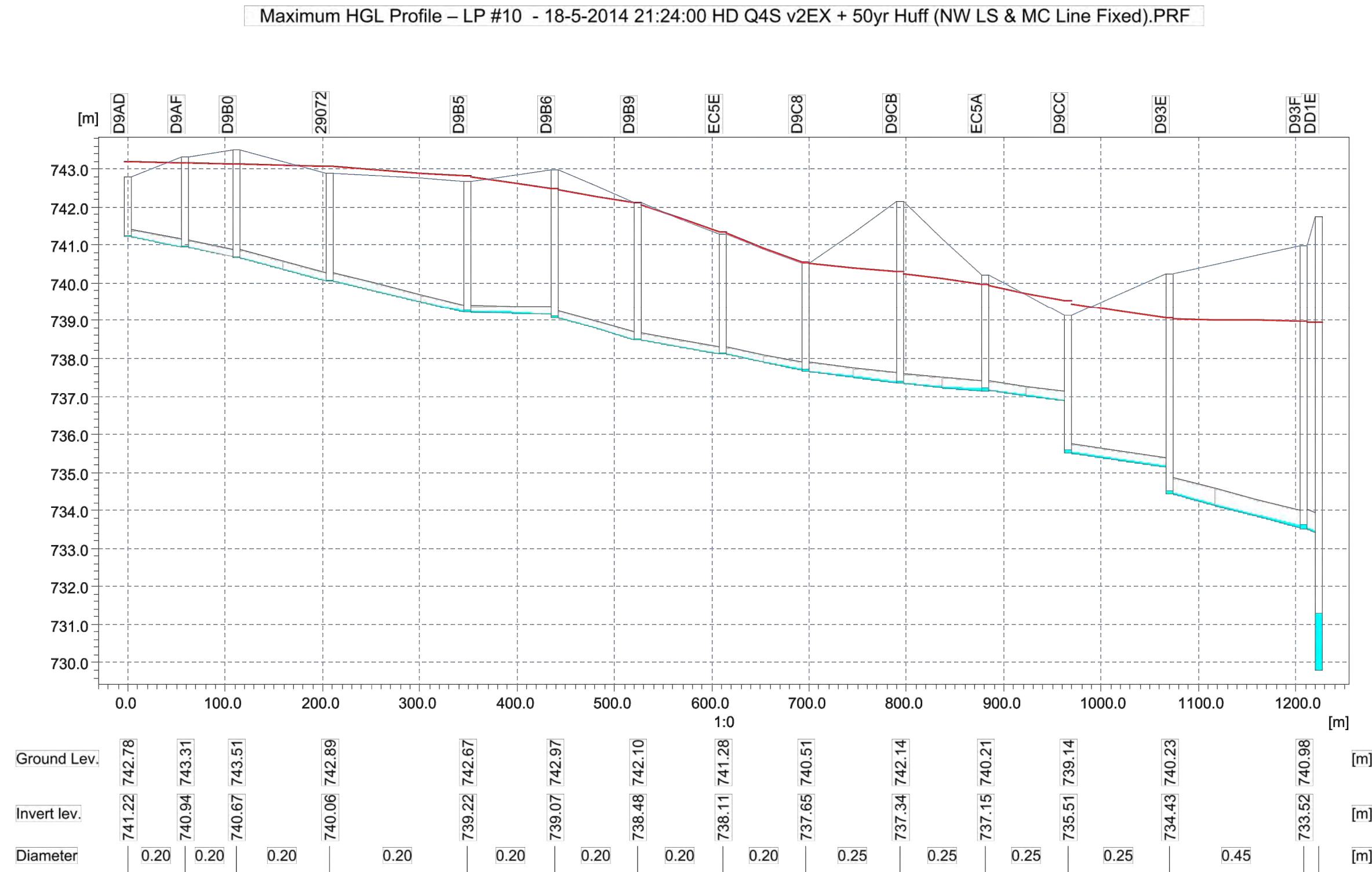


FIGURE 5.13.10



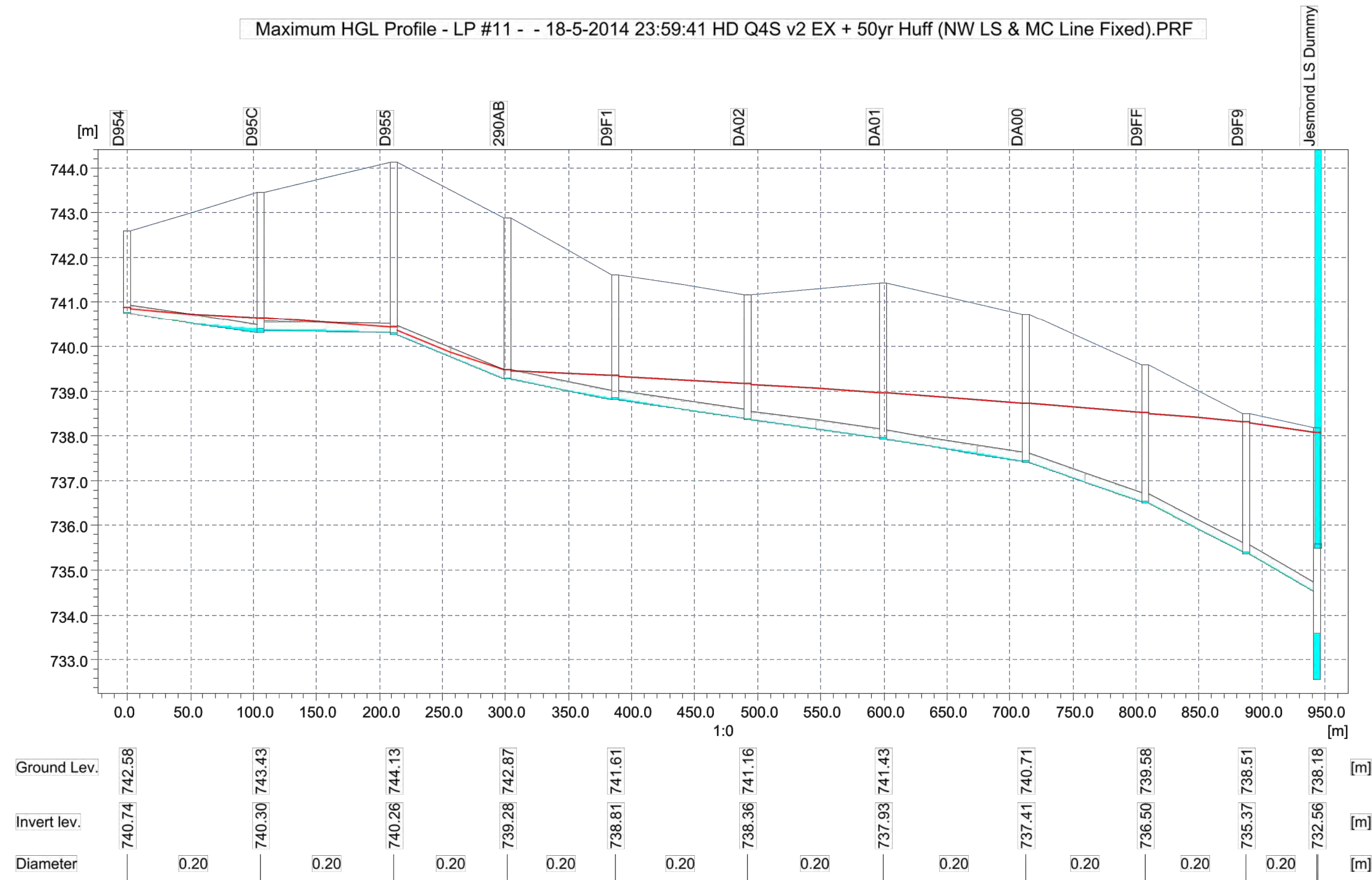
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #9**

FIGURE 5.13.11



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #10**

FIGURE 5.13.12



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**50YR 24HR HUFF Q4 STORM**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP #11**



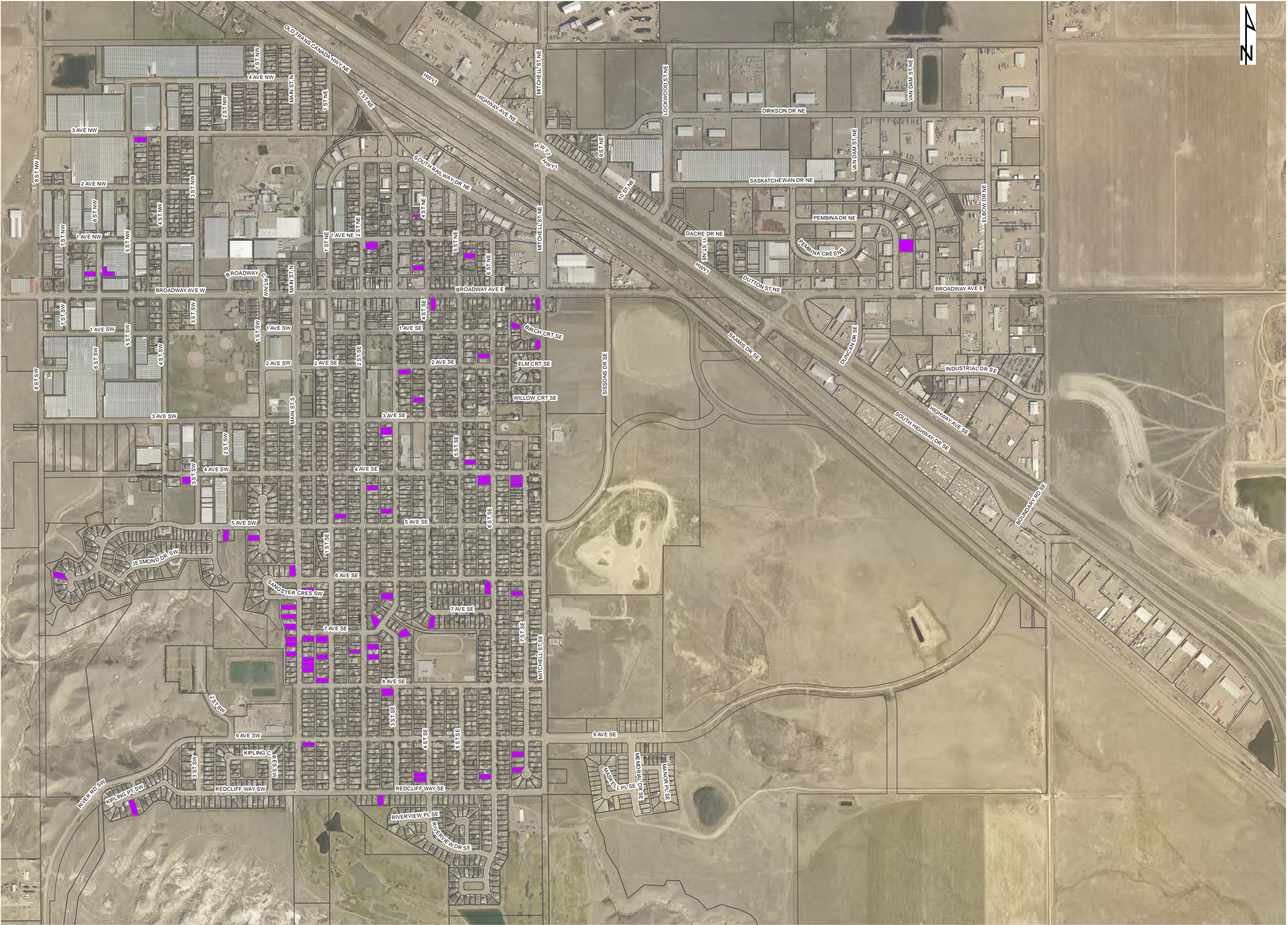

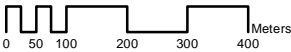


FIGURE 6.1

Legend

 Lots Reporting Sewer Backup

1:12,500



TOWN OF REDCLIFF  
SANITARY I-I STUDY  
SURVEY RESULTS  
SEWER BACKUP LOCATIONS BY LOT





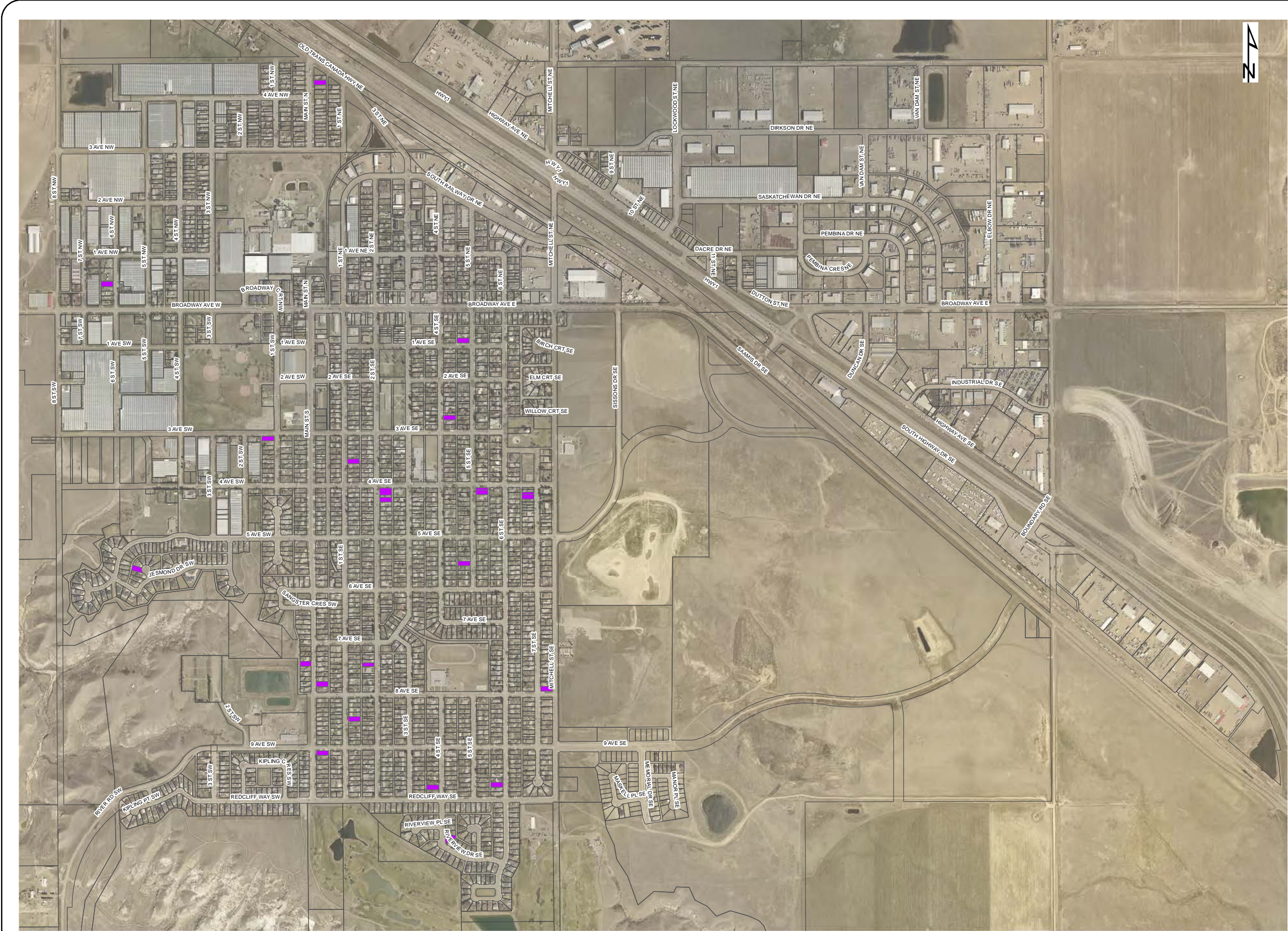
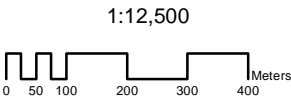


FIGURE 6.2

Legend

 Lots Reporting Roof Leaders To Unknown Destination



TOWN OF REDCLIFF  
SANITARY I-I STUDY

SURVEY RESULTS  
ROOF LEADERS  
LOCATION BY LOT





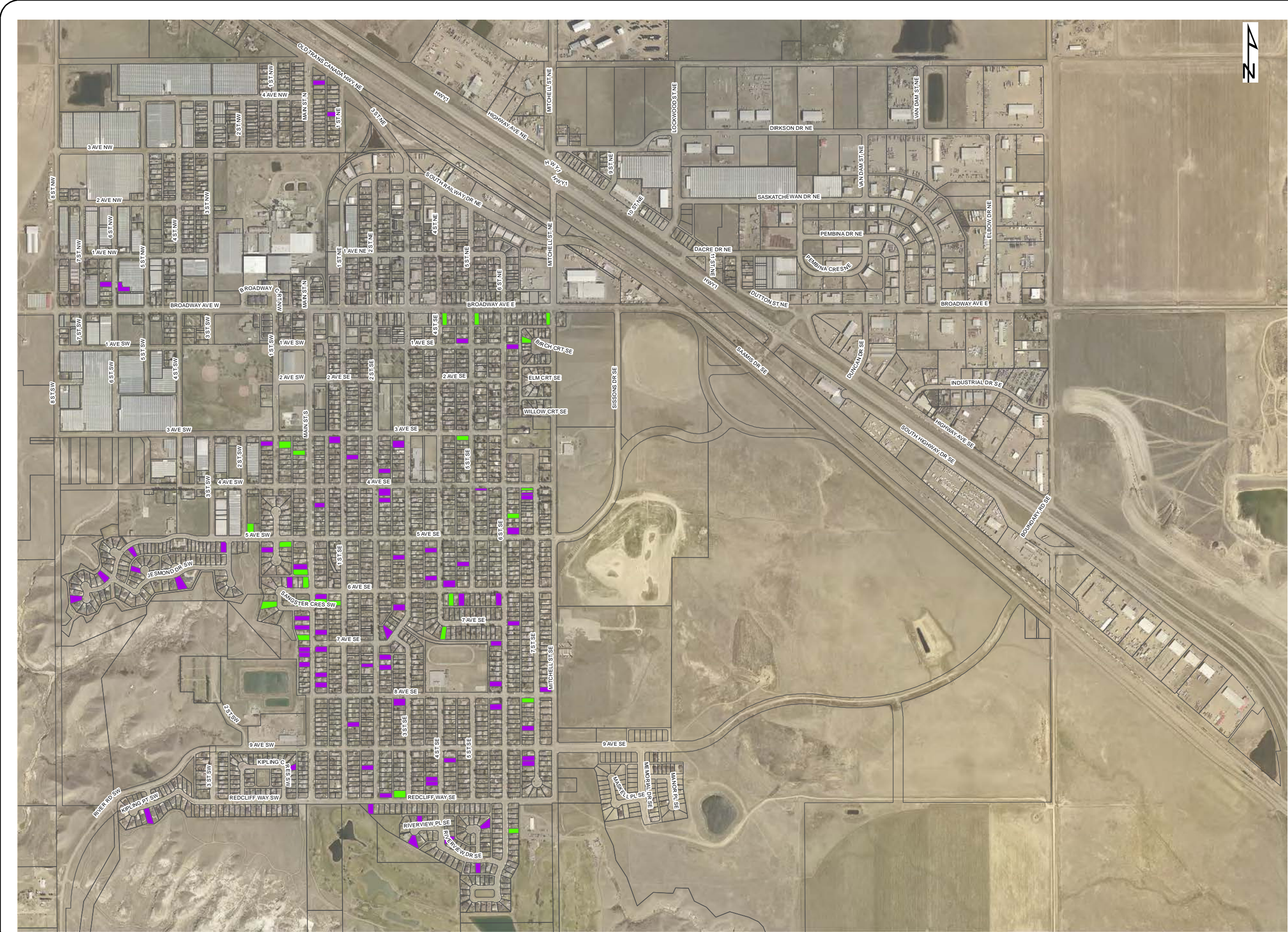


FIGURE 6.3

Legend

- Lots Reporting Weeping Tiles To Sanitary
- Lots Reporting Weeping Tiles To Unknown Destination

1:12,500



TOWN OF REDCLIFF  
SANITARY I-I STUDY

SURVEY RESULTS  
WEEPING TILE  
LOCATION BY LOT





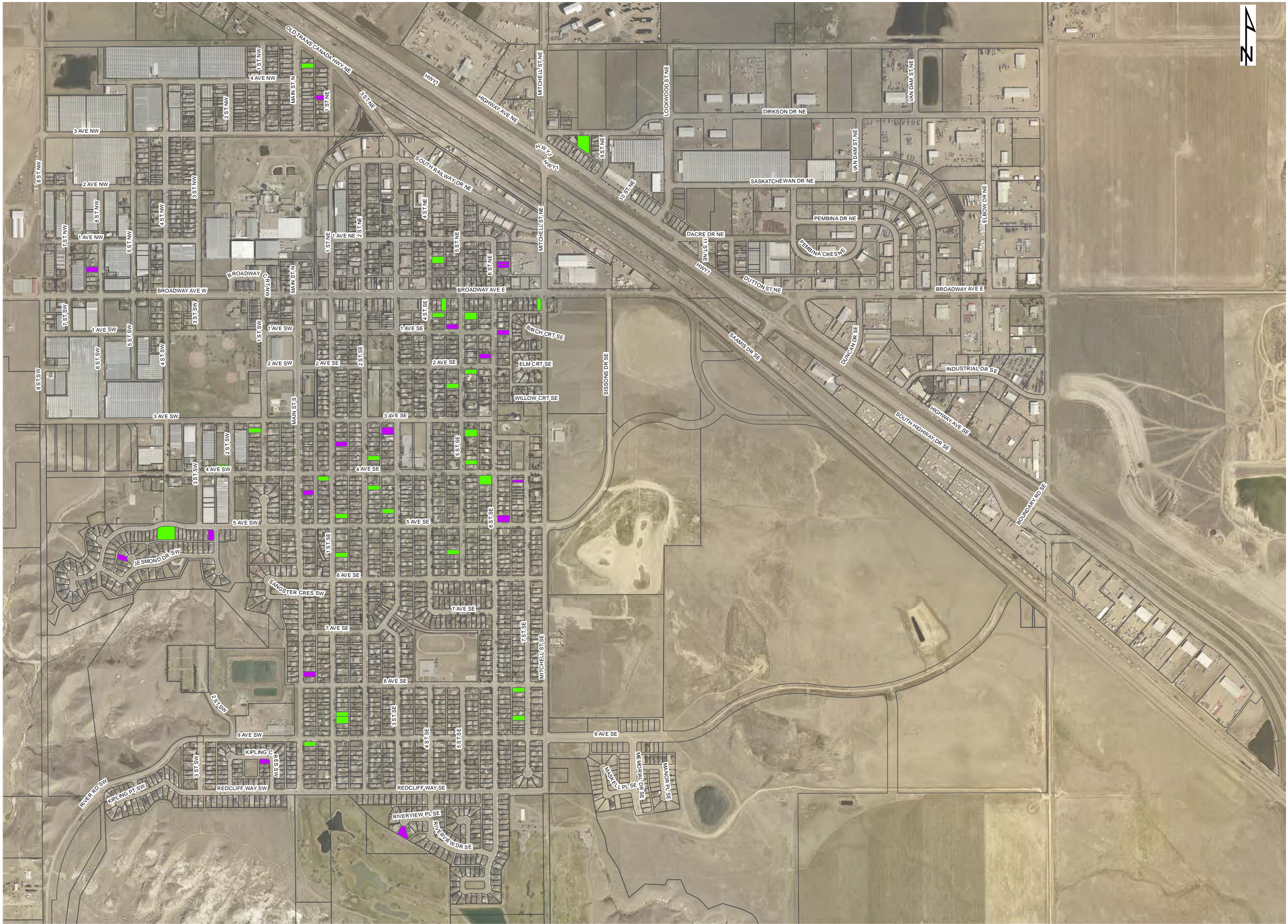
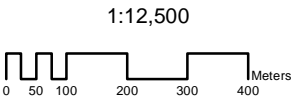


FIGURE 6.4

Legend

- Lots Reporting Sump Pump To Sanitary
- Lots Reporting Sump Pump To Unknown Destination



TOWN OF REDCLIFF  
SANITARY I-I STUDY

SURVEY RESULTS  
SUMP PUMP  
LOCATION BY LOT





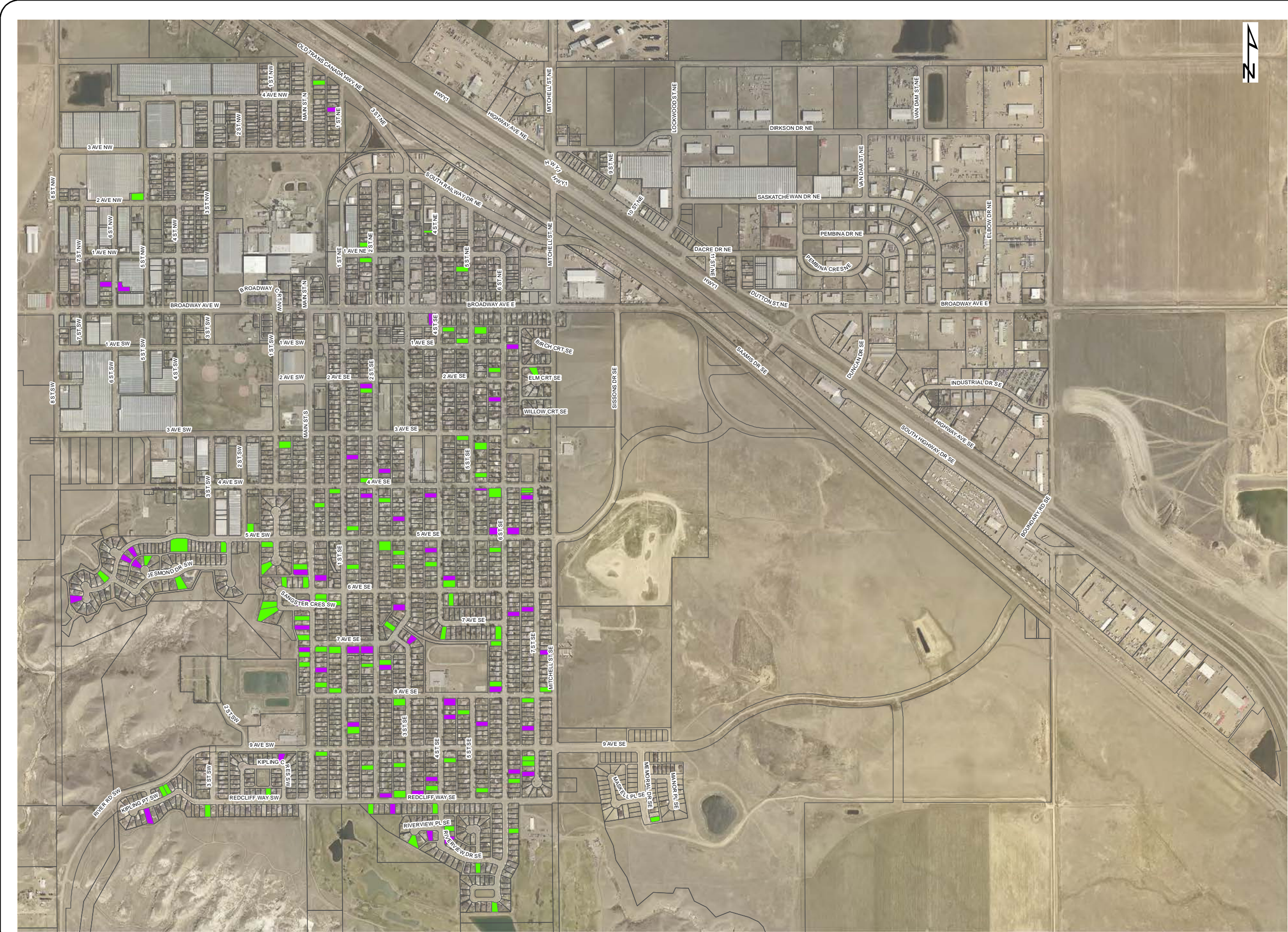
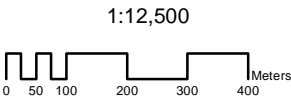


FIGURE 6.5

# Legend

- Lots Reporting Basement Drain to Sanitary
- Lots Reporting Basement Drain to Unknown Destination



TOWN OF REDCLIFF  
SANITARY I-I STUDY

SURVEY RESULTS  
BASEMENT DRAIN  
LOCATION BY LOT



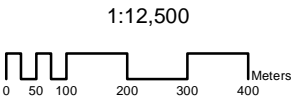




FIGURE 6.6

Legend

 Lots Reporting Sewer Backup Due To June 2013 Event



TOWN OF REDCLIFF  
SANITARY I-I STUDY

SURVEY RESULTS  
SEWER BACKUPS JUNE 2013 EVENT  
LOCATION BY LOT





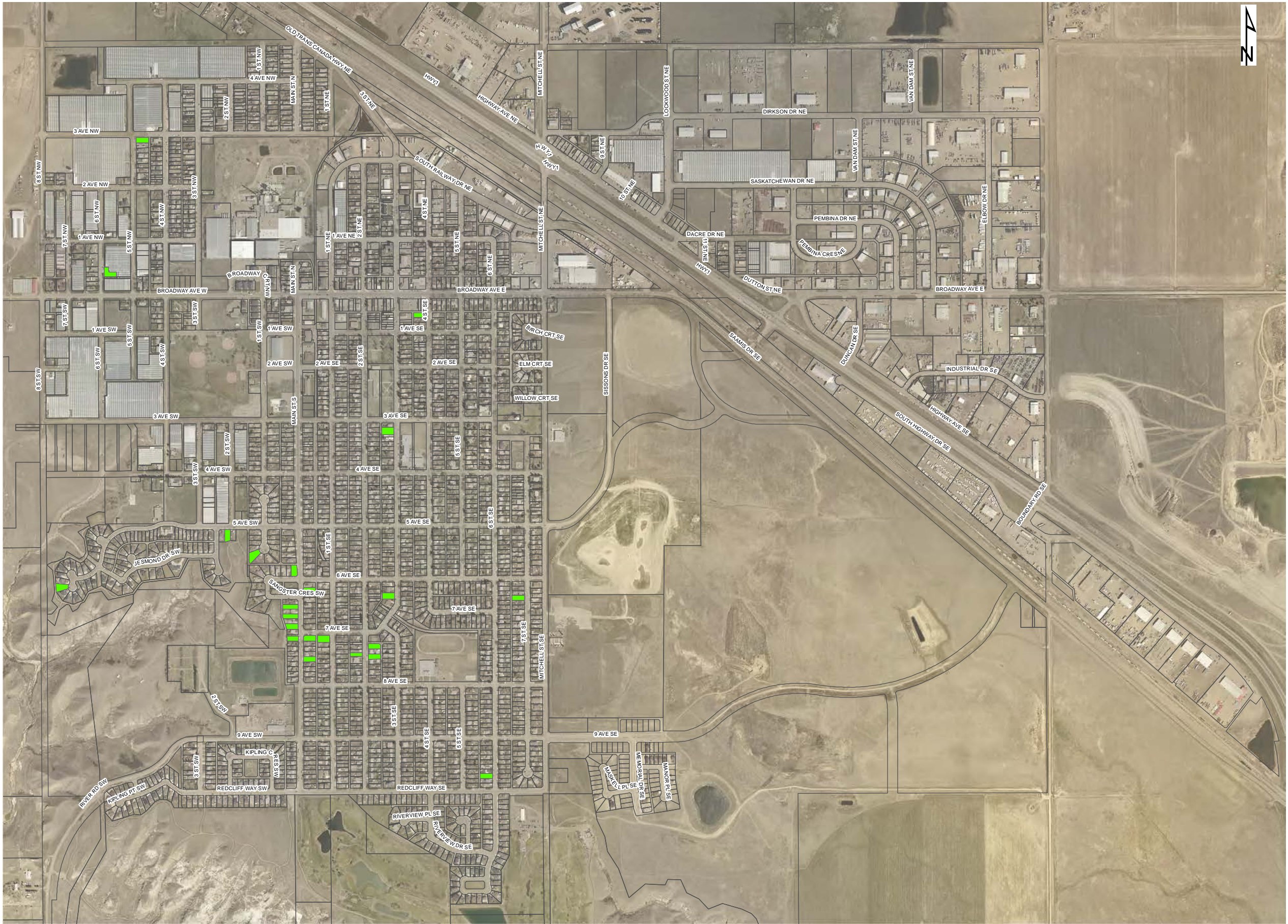


FIGURE 6.7

## Legend

 Lots Reporting Sewer Backup Due To July 2013 Event

1:12,500

0 50 100 200 300 400 Meters



TOWN OF REDCLIFF  
SANITARY I-I STUDY

SURVEY RESULTS  
SEWER BACKUPS JULY 2013 EVENT  
LOCATION BY LOT



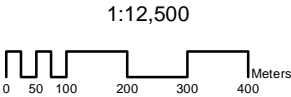




FIGURE 6.8

Legend

- MANHOLE COVER (MHC)
- RAIN WATER LEADER DOWN SPOUT (RWL)
- CLEANOUT CAP DEFECTIVE (CCD)
- SERVICE CONNECTION (SC)



TOWN OF REDCLIFF  
SANITARY I-I STUDY

SMOKE TEST RESULTS  
INCIDENTS BY TYPE





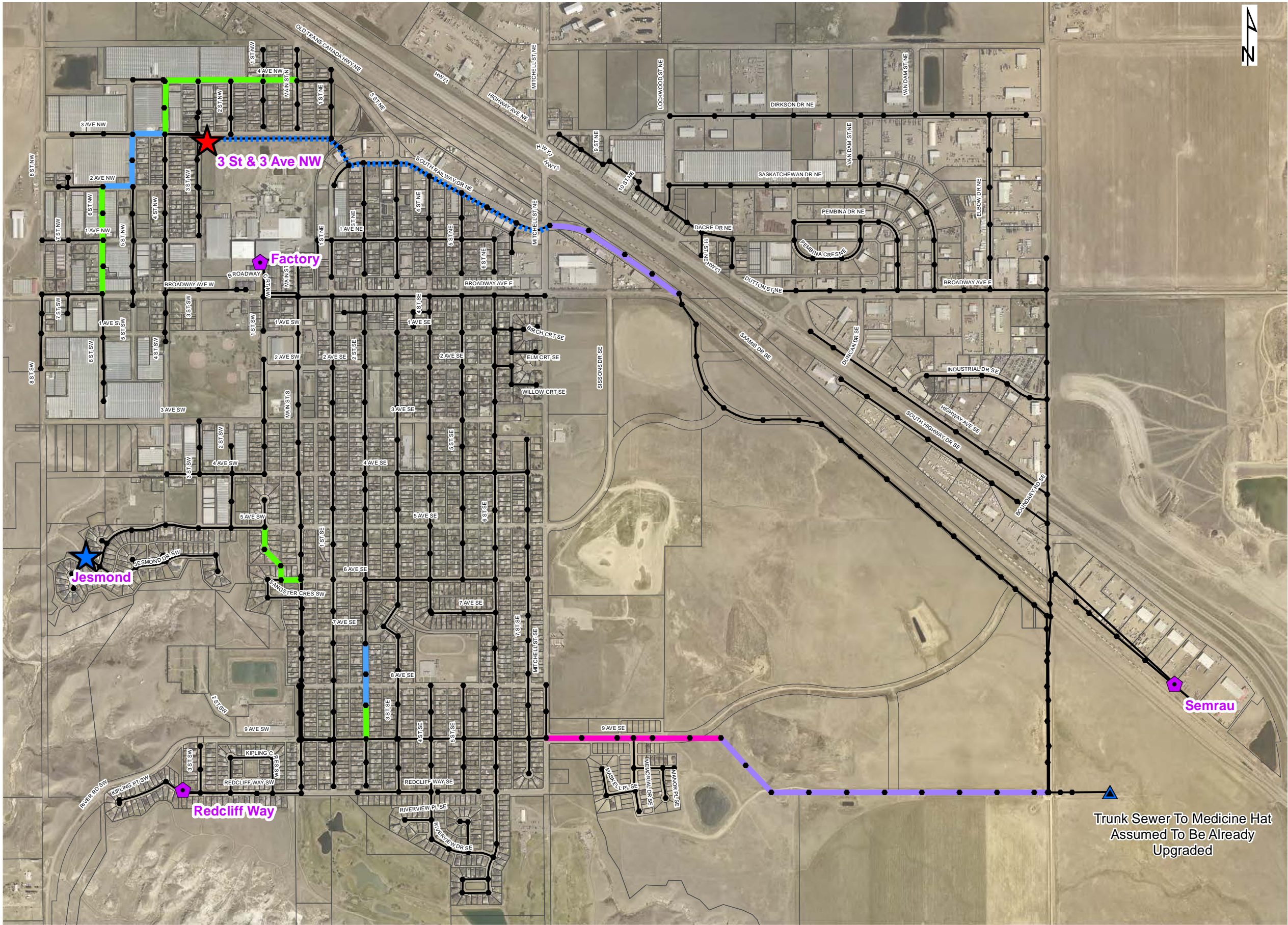


FIGURE 7.1

## Legend

### Sanitary Gravity Trunk

- Proposed Twin 200mm
- Proposed Twin 250mm
- Proposed Twin 300mm
- Proposed Twin 375mm

### Sanitary Forcemain

- Proposed Twin 250mm

### Proposed Lift Station

- New Capacity of 167L/s
- New Active Storage of 60.5 cu.m
- Existing Lift Station
- Existing Sanitary Trunk

1:12,500



TOWN OF REDCLIFF  
SANITARY I-I STUDY  
CONCEPTUAL UPGRADES  
(WITH SEWER TO MEDICINE HAT UPSIZED)  
EXISTING SYSTEM PLUS  
50YR 24HR HUFF Q4 STORM





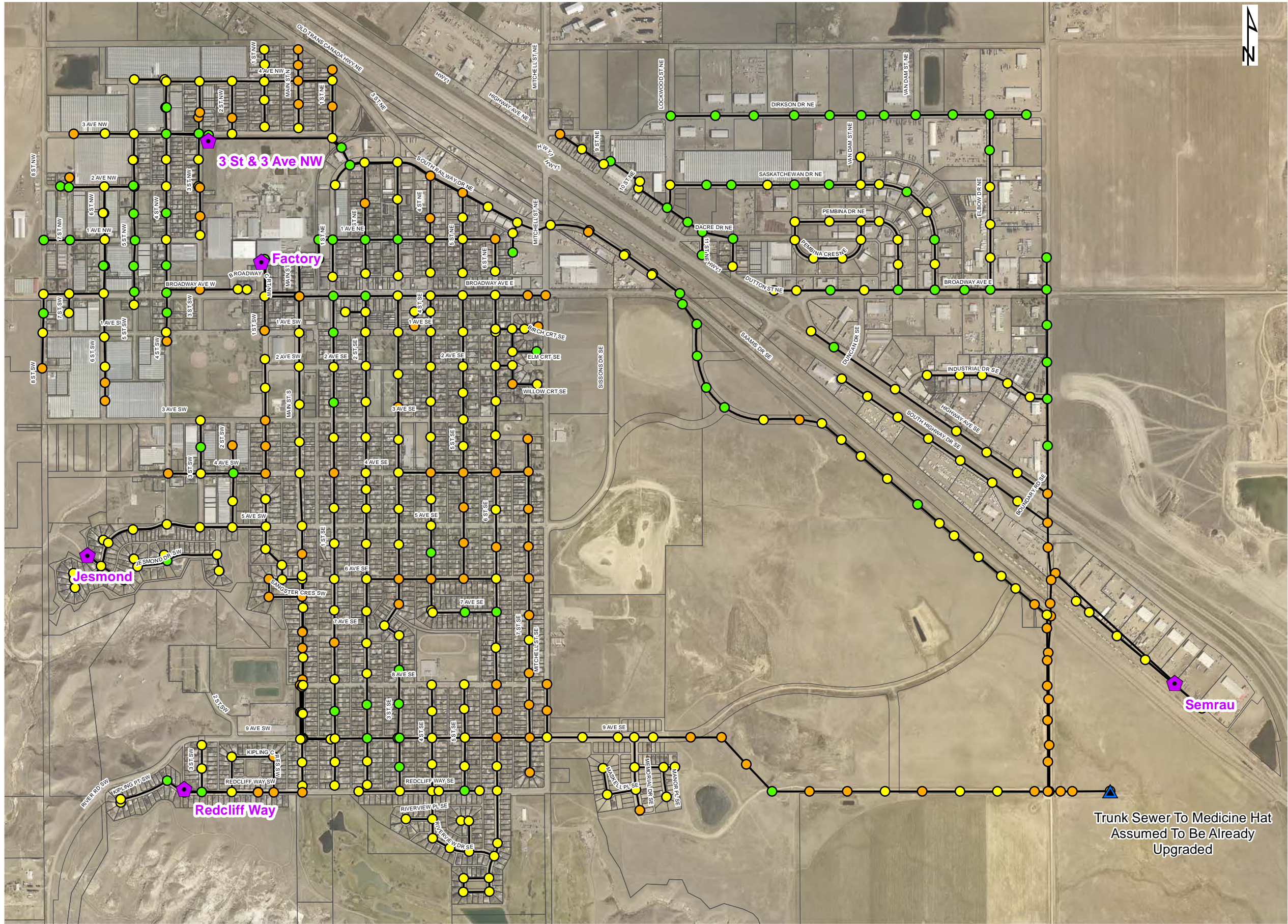


FIGURE 7.2

## Legend

- Less Than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and -0.50m
- Greater Than 0.00m
- Sanitary Trunk
- Lift Station

1:12,500

0 50 100 200 300 400 Meters



### TOWN OF REDCLIFF SANITARY I-I STUDY

PEAK HGL RELATIVE TO GROUND  
UPGRADED EXISTING SYSTEM WITH  
MEDICINE HAT SEWER UPSIZED  
PLUS 50YR 24HR HUFF Q4 STORM





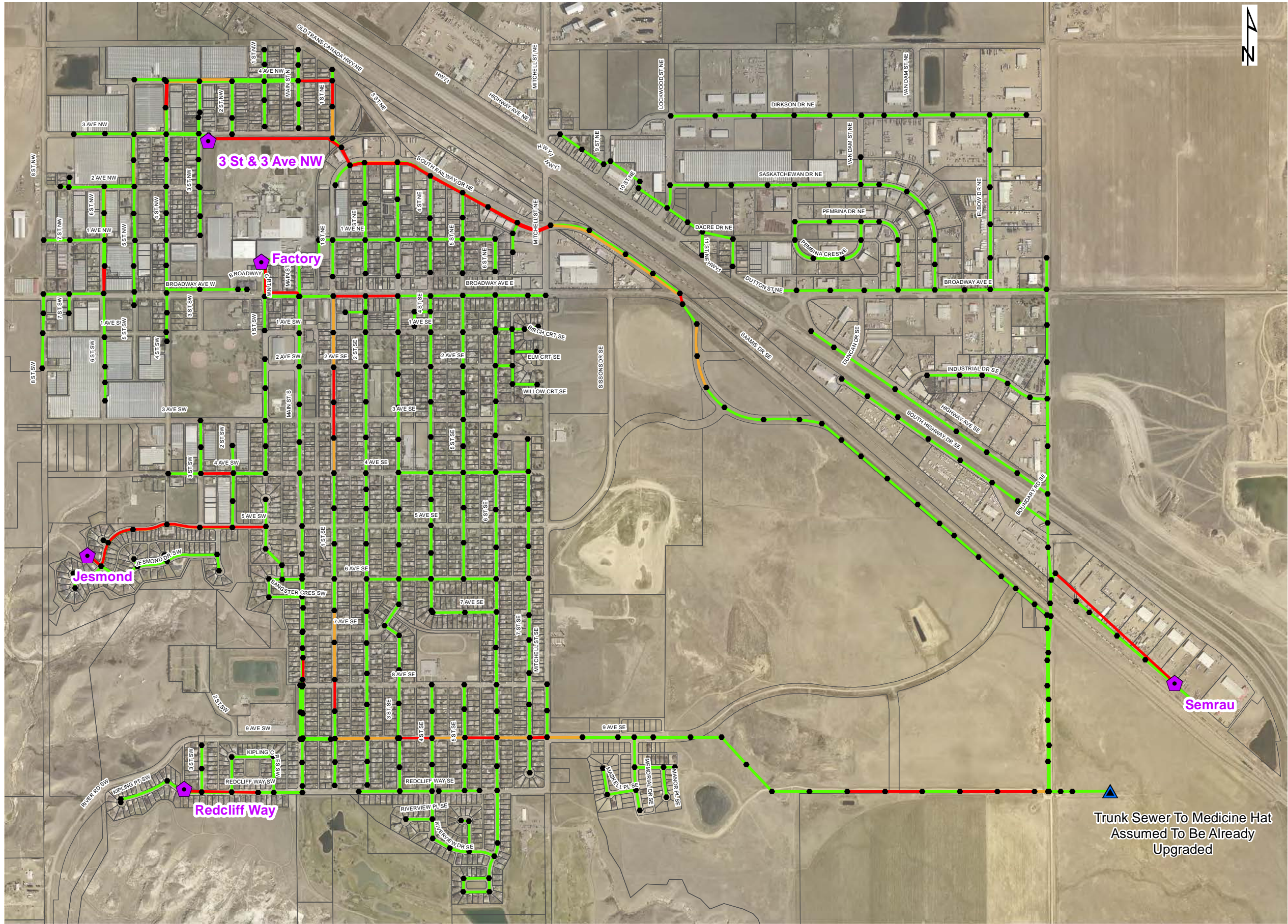


FIGURE 7.3

Legend

- Greater Than 100%
- Between 86% and 100%
- Less Than 86%
- Lift Station

1:12,500



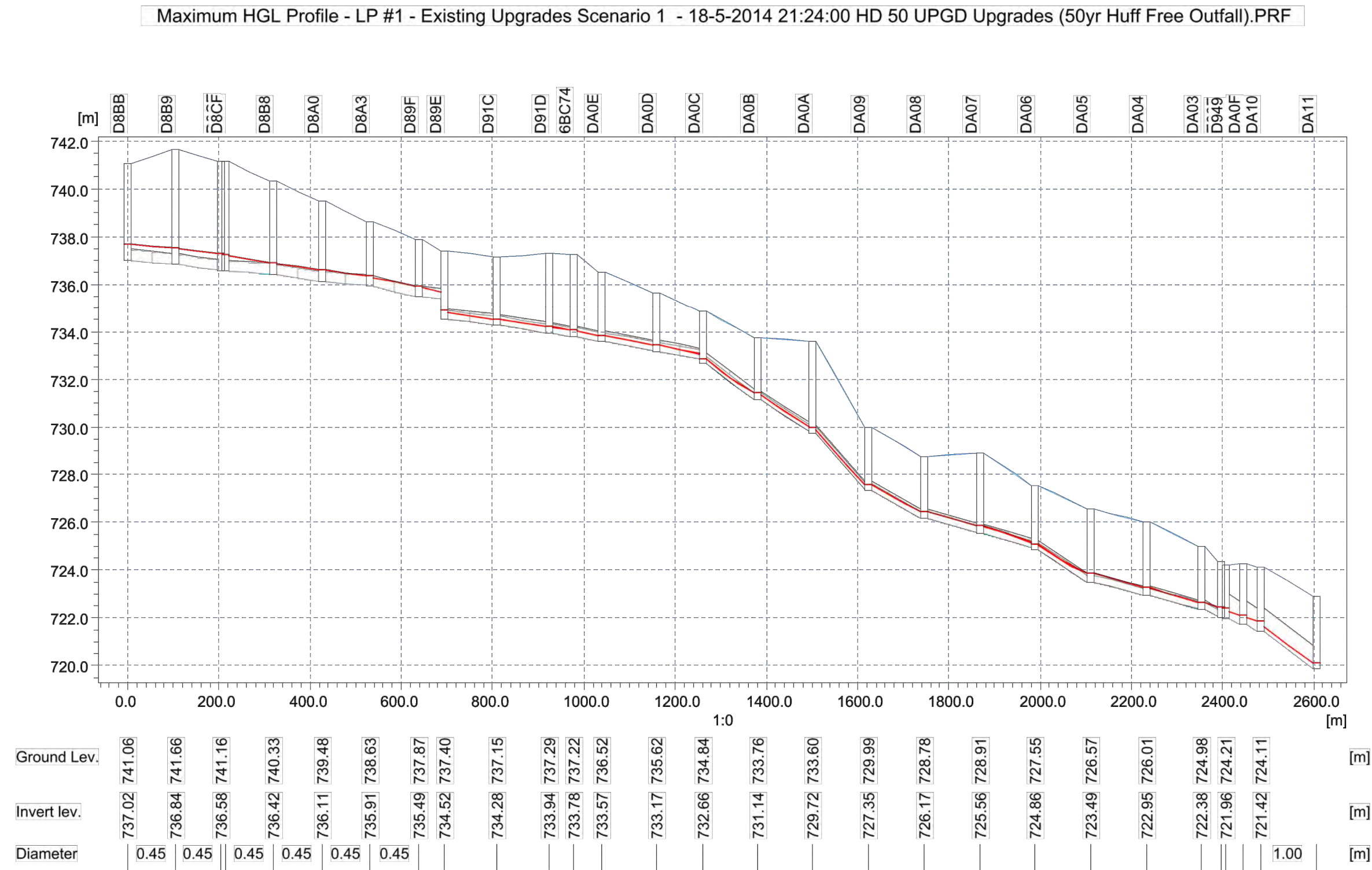
TOWN OF REDCLIFF  
SANITARY I-I STUDY

PEAK DISCHARGE RELATIVE TO PIPE CAPACITY  
UPGRADED EXISTING SYSTEM WITH  
MEDICINE HAT SEWER UPSIZED  
PLUS 50YR 24HR HUFF Q4 STORM





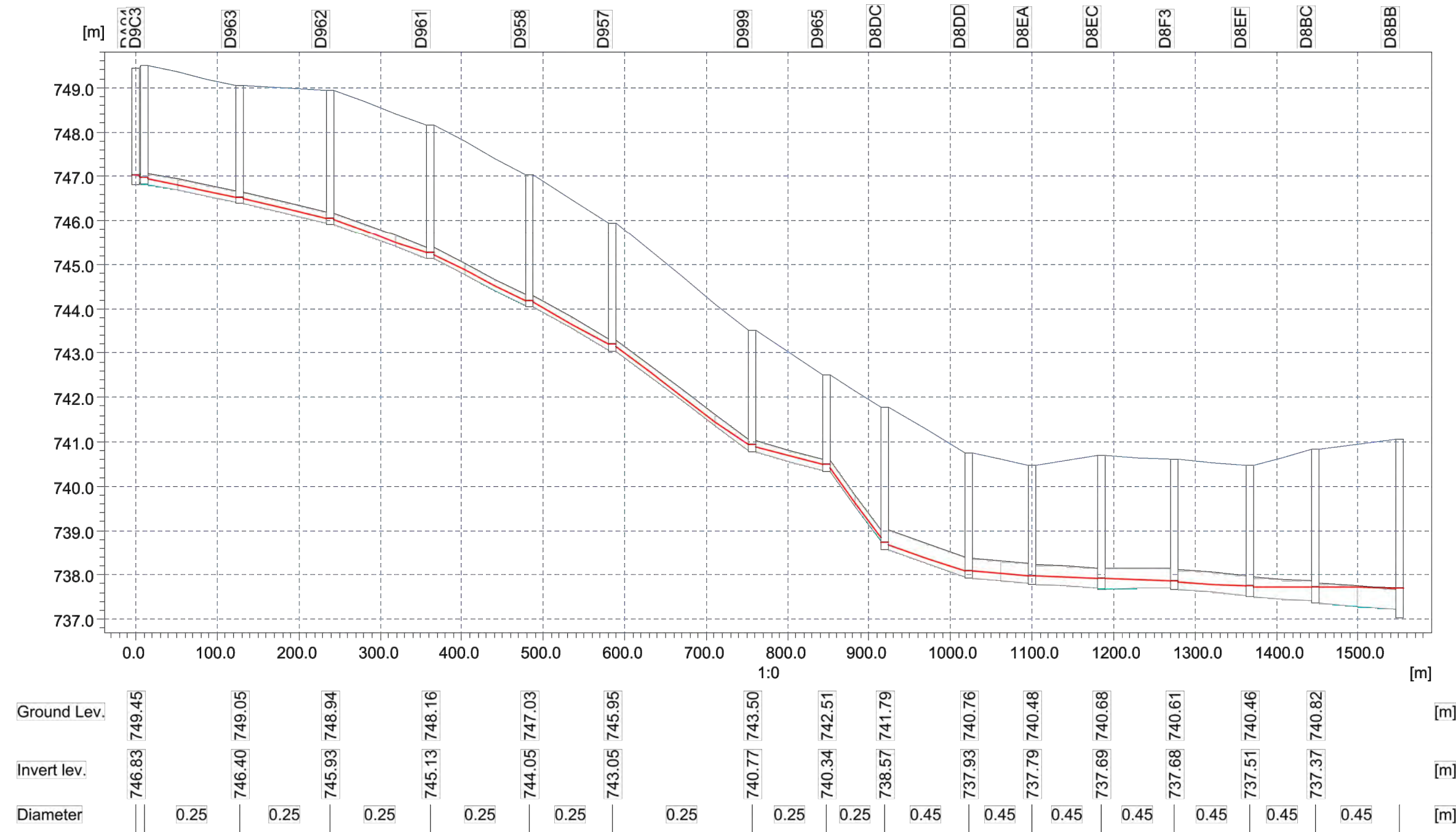
FIGURE 7.4.1



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #1**

FIGURE 7.4.2

Maximum HGL Profile – LP #2A – Existing Upgrades Scenario 1 - 18-5-2014 21:24:00 HD 50 UPGD Upgrades (50yr Huff Free Outfall).PRF

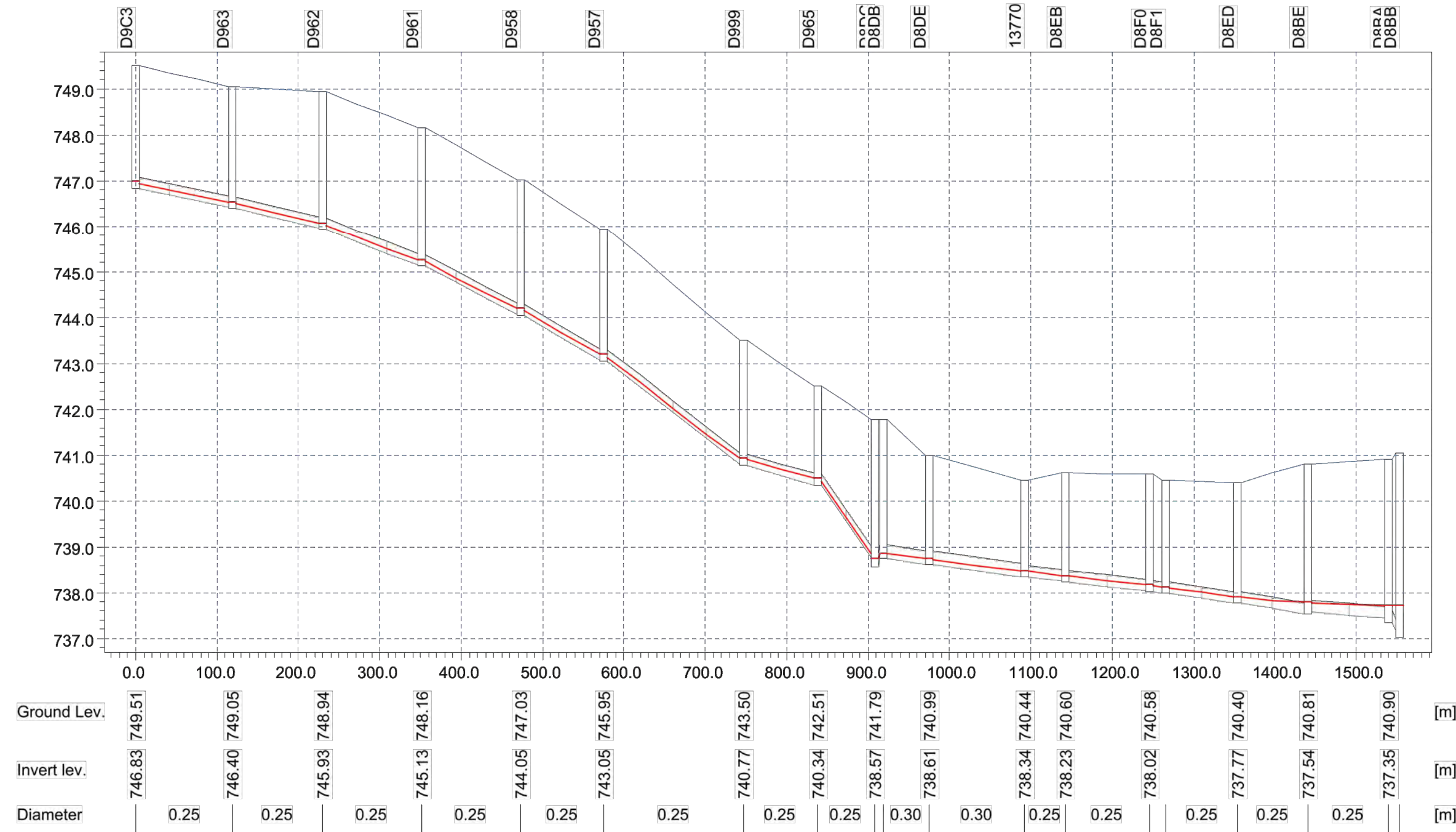


**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #2A**



FIGURE 7.4.3

Maximum HGL Profile – LP #2B – Existing Upgrades Scenario 1 - 18-5-2014 21:24:00 HD 50 UPGD Upgrades (50yr Huff Free Outfall).PRF



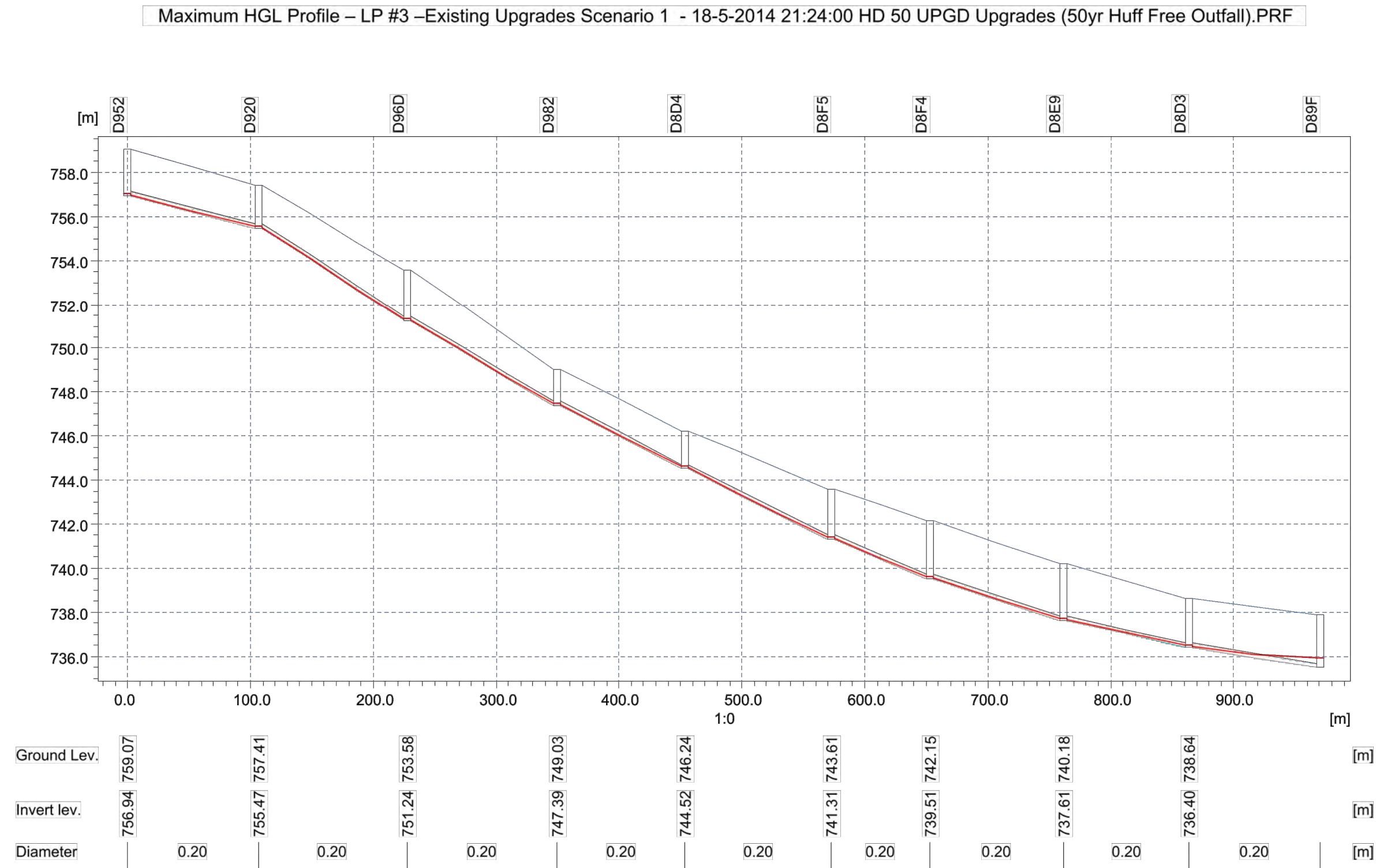
**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #2B**



RAFAL JADZINSKI, Apr. 7, 15 10:59:58 AM N: 26000.26031\_REDCLIFF\_SANITARY\_H\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\LP5\EX UPGRADES - (NW LS & WC SEWER FIXED)\26031\_MAX HGL PROFILES -UPGRADES 50YR HUFF 24HR HUFF 04 STORM (NW LS & WC LINE PROFILES)



FIGURE 7.4.4

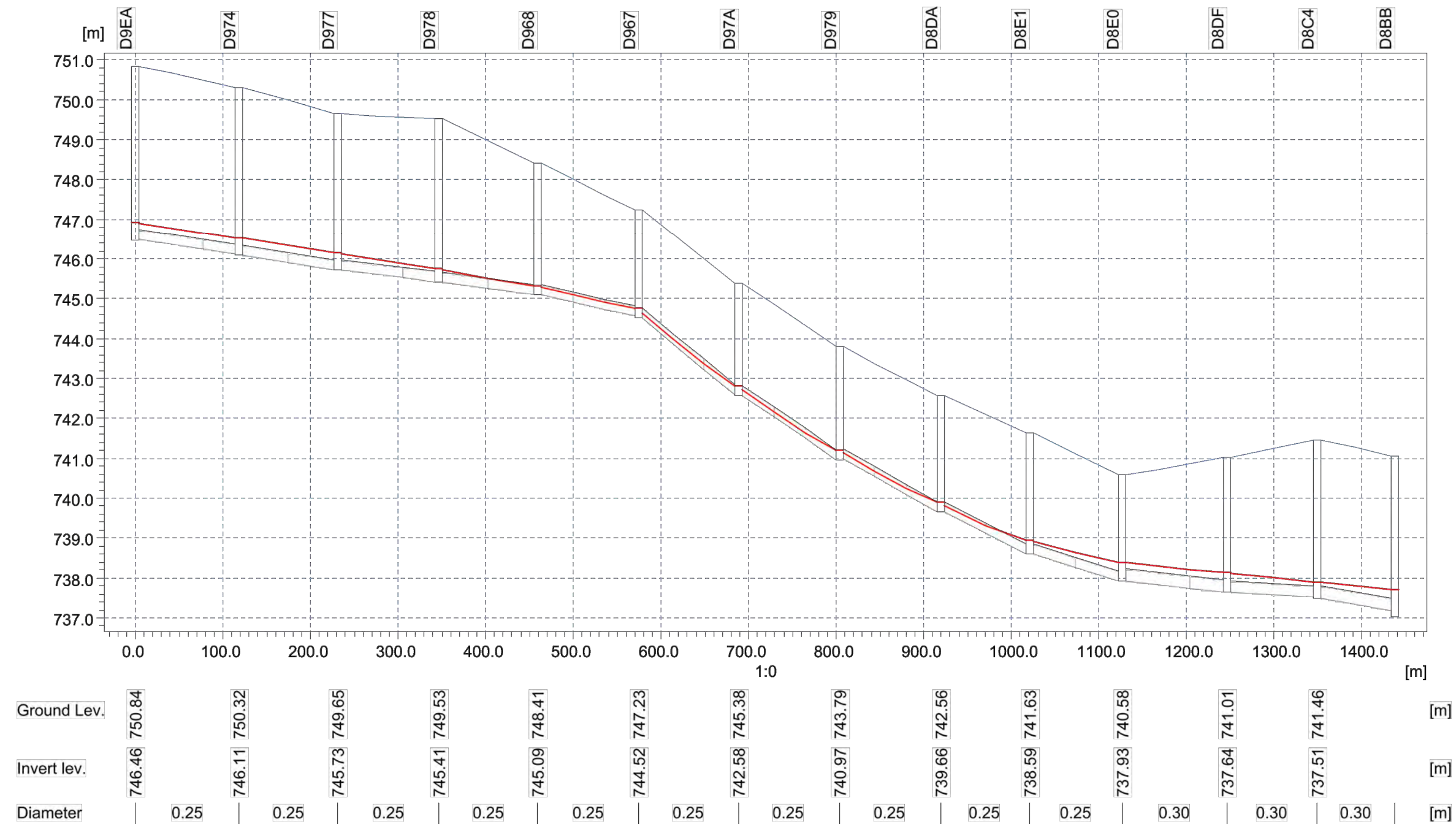


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #3**

RAFAL JADZINSKI, Apr. 7, 15 11:05:00 AM, N: 26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (NW, LS & MC SEWER FIXED)\26031\_MAX HGL PROFILES - UPGRADES 50YR 24HR HUFF Q4 STORM (NW, LS & MC SEWER FIXED).PRF

FIGURE 7.4.5

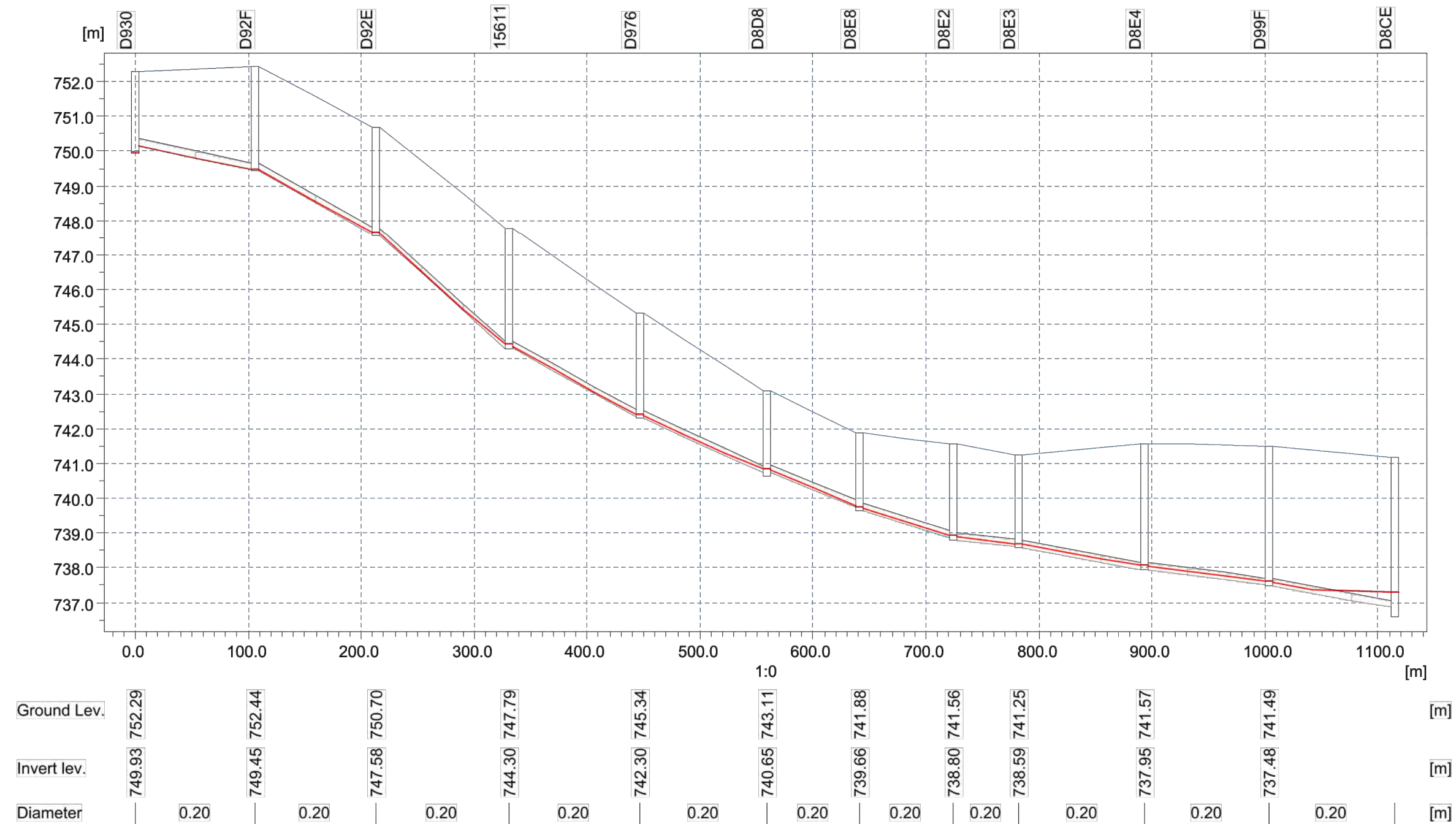
Maximum HGL Profile – LP #4 –Existing Upgrades Scenario 1 - 18-5-2014 21:24:00 HD 50 UPGD Upgrades (50yr Huff Free Outfall).PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #4**

FIGURE 7.4.6

Maximum HGL Profile – LP #5 –Existing Upgrades Scenario 1 - 18-5-2014 21:24:00 HD 50 UPGD Upgrades (50yr Huff Free Outfall).PRF

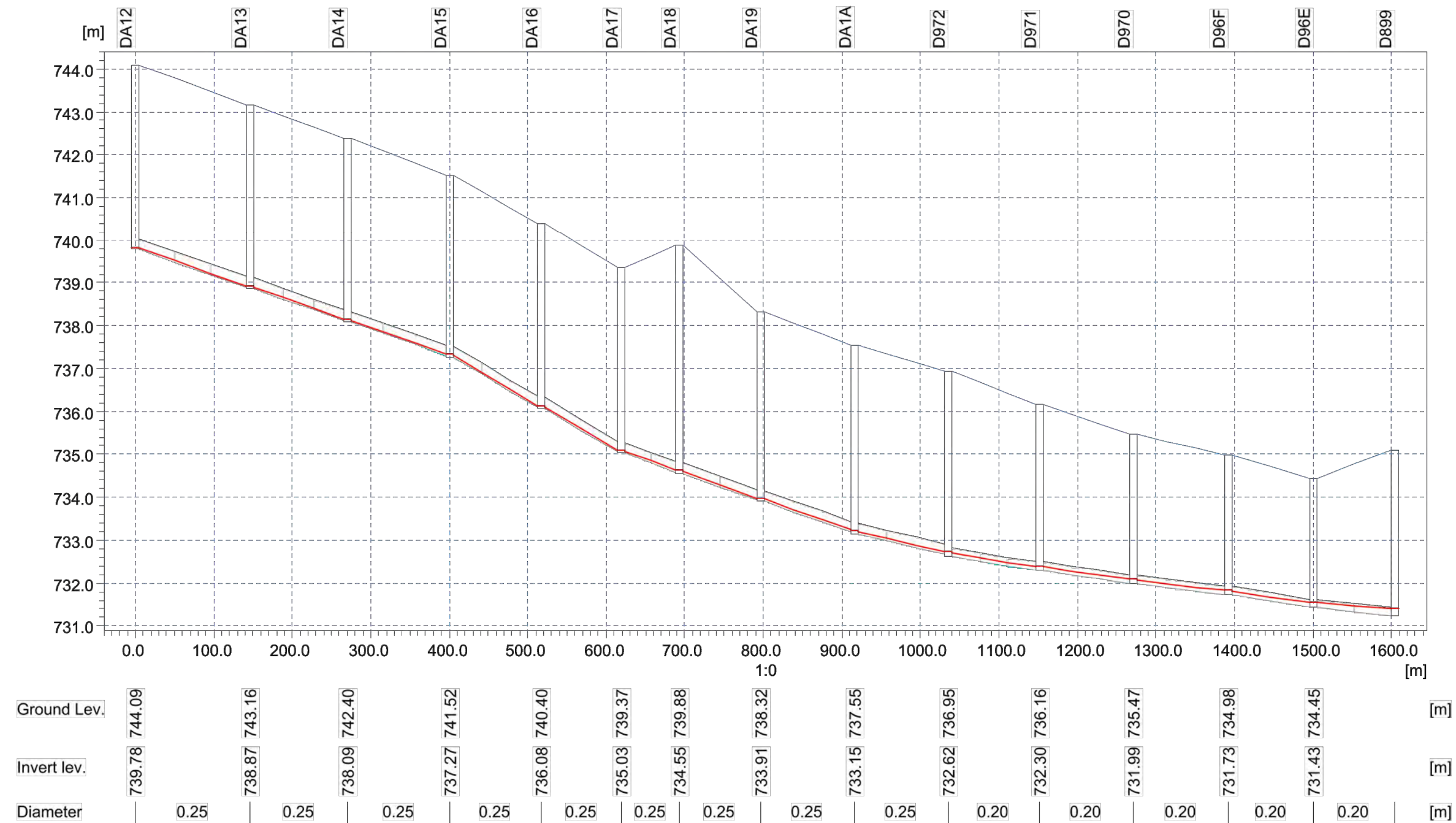


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #5**



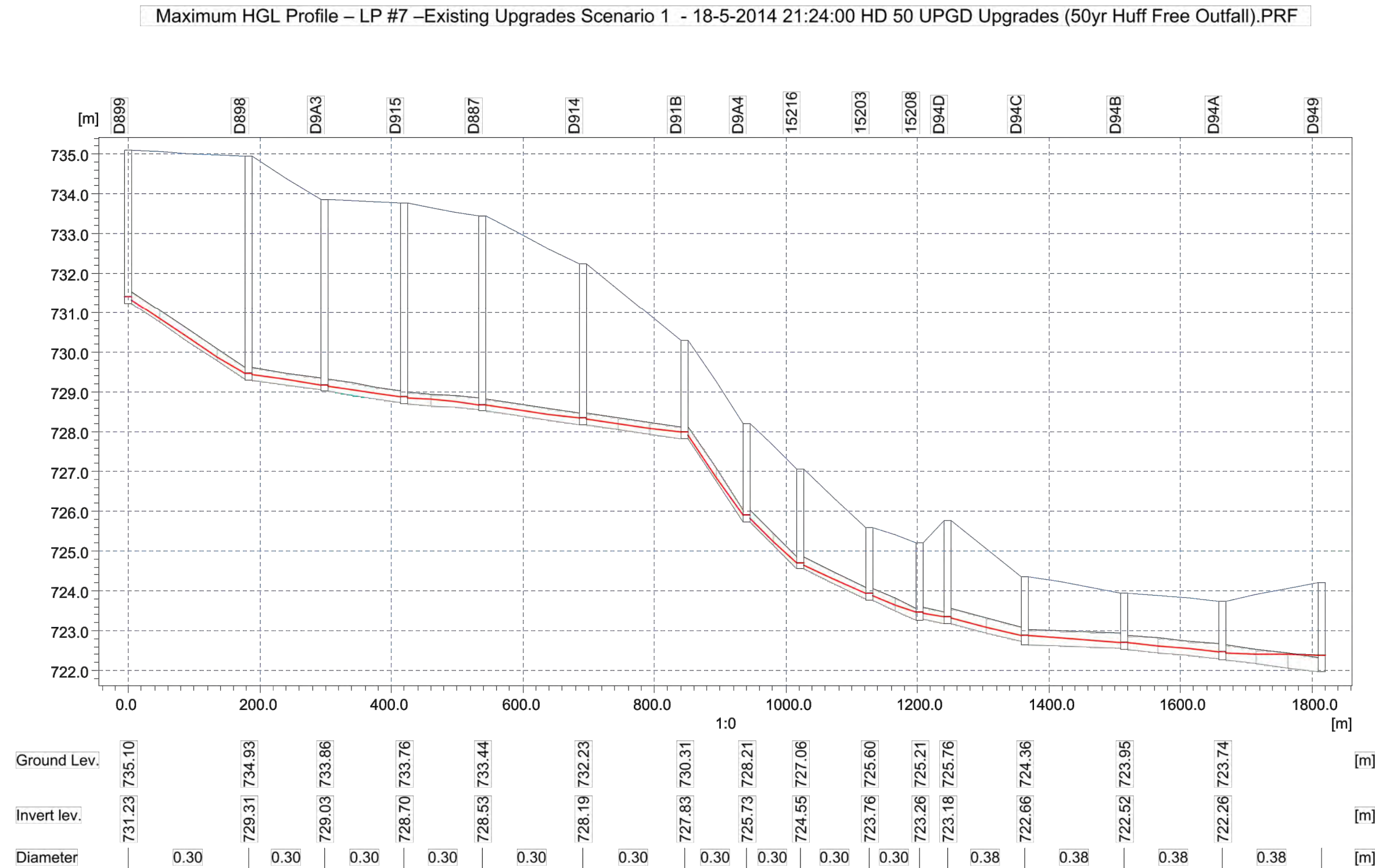
FIGURE 7.4.7

Maximum HGL Profile – LP #6 –Existing Upgrades Scenario 1 - 18-5-2014 21:24:00 HD 50 UPGD Upgrades (50yr Huff Free Outfall).PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #6**

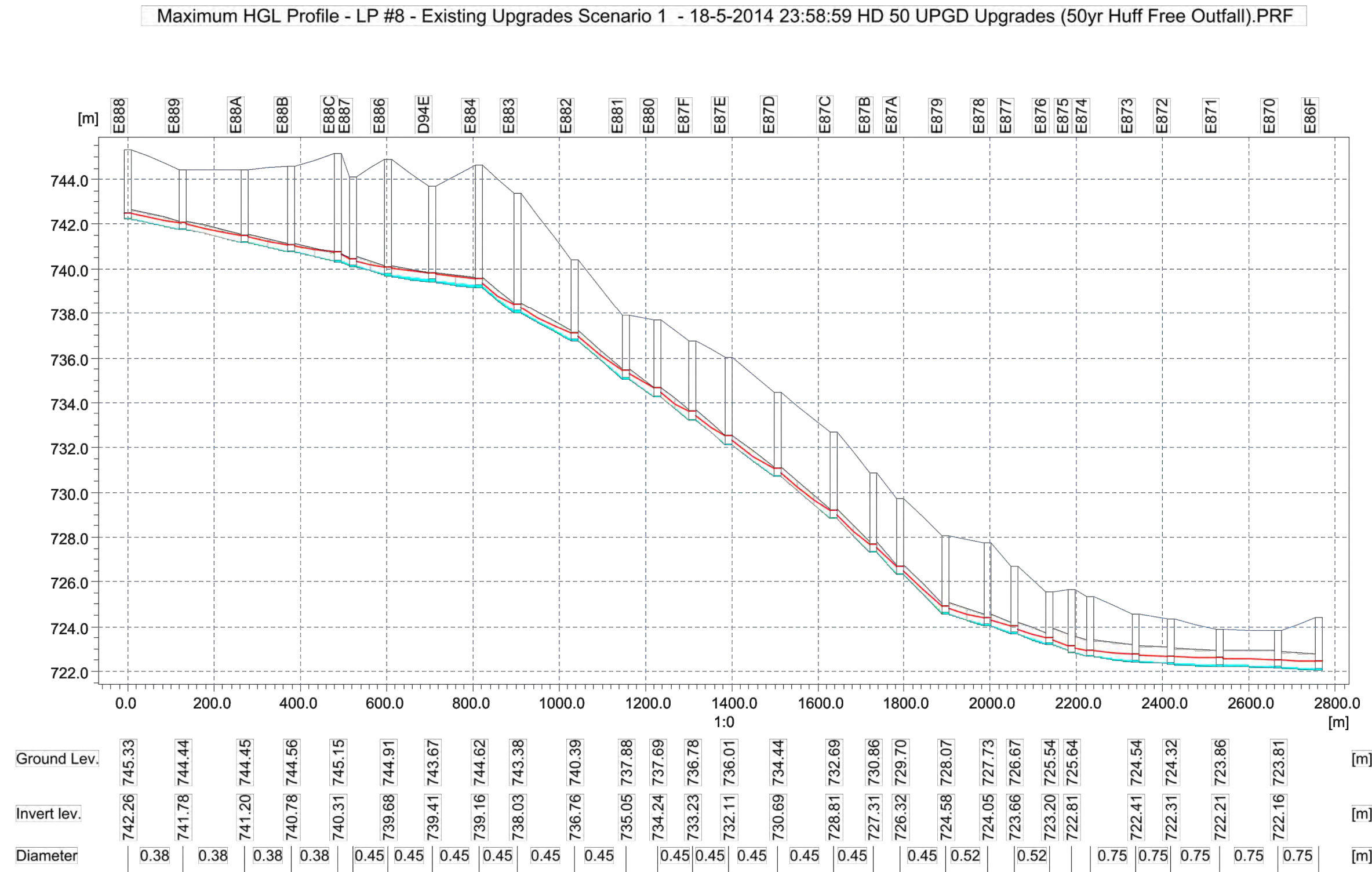
FIGURE 7.4.8



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #7**

RAFAL\_JADZINSKI Apr. 7, 15 11:05:04 AM N: 26000\26031\_REDCLIFF\_SANITARY\_H\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (NW LS & MC SEWER FIXED)\26031\_MAX HGL PROFILES -UPGRADES 50YR 24HR HUFF Q4 STORM (NW LS & MC SEWER FIXED).DWG

FIGURE 7.4.9

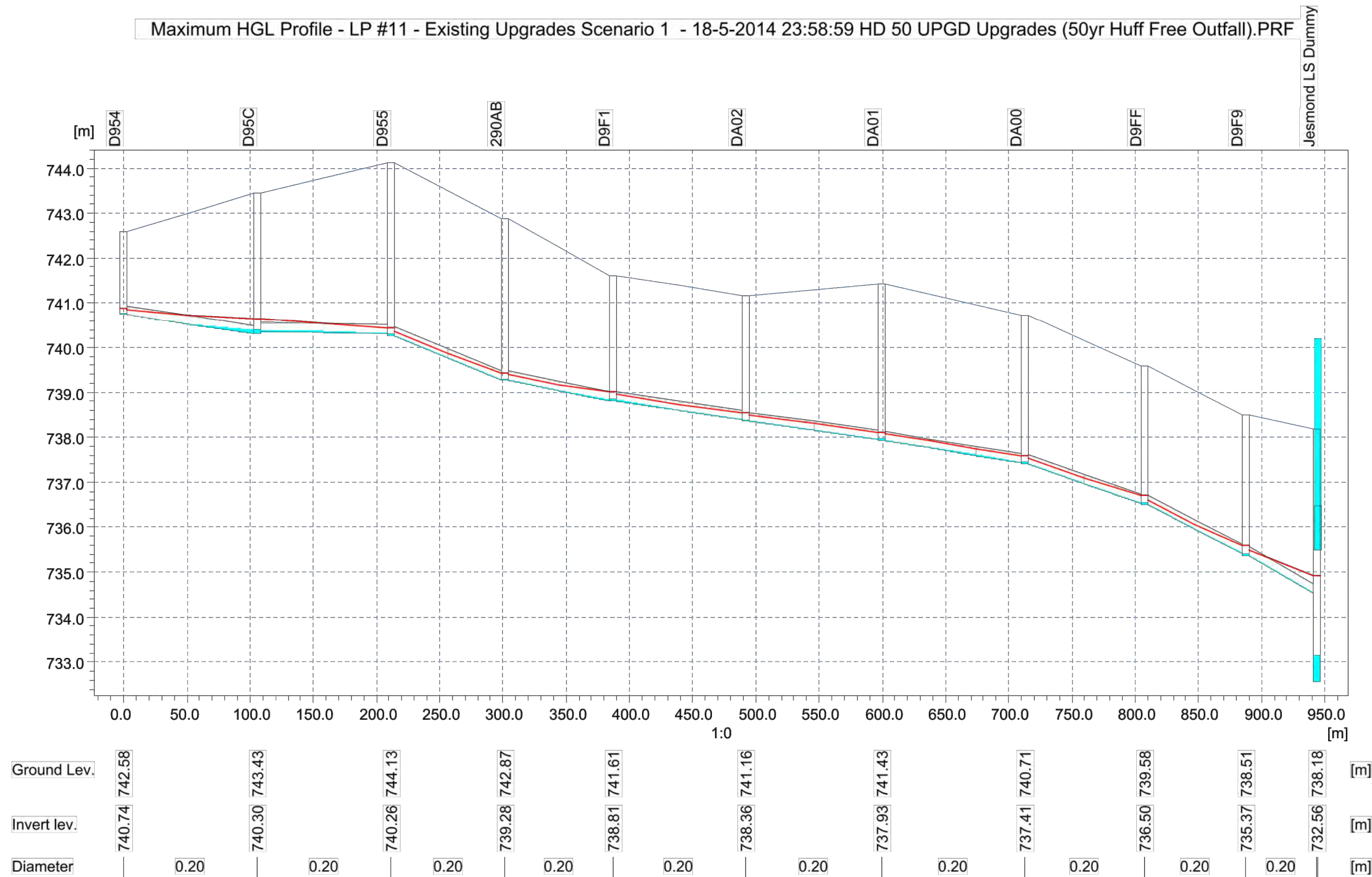


**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #8**

RAFAL\_JADZINSKI Apr. 7, 15 11:05:05 AM N: 26000\26031\_REDCLIFF\_SANITARY\_...\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (NW LS & MC SEWER FIXED)\26031\_MAX HGL PROFILES -UPGRADES 50YR 24HR HUFF Q4 STORM (NW LS & MC LINE FIXED).DWG



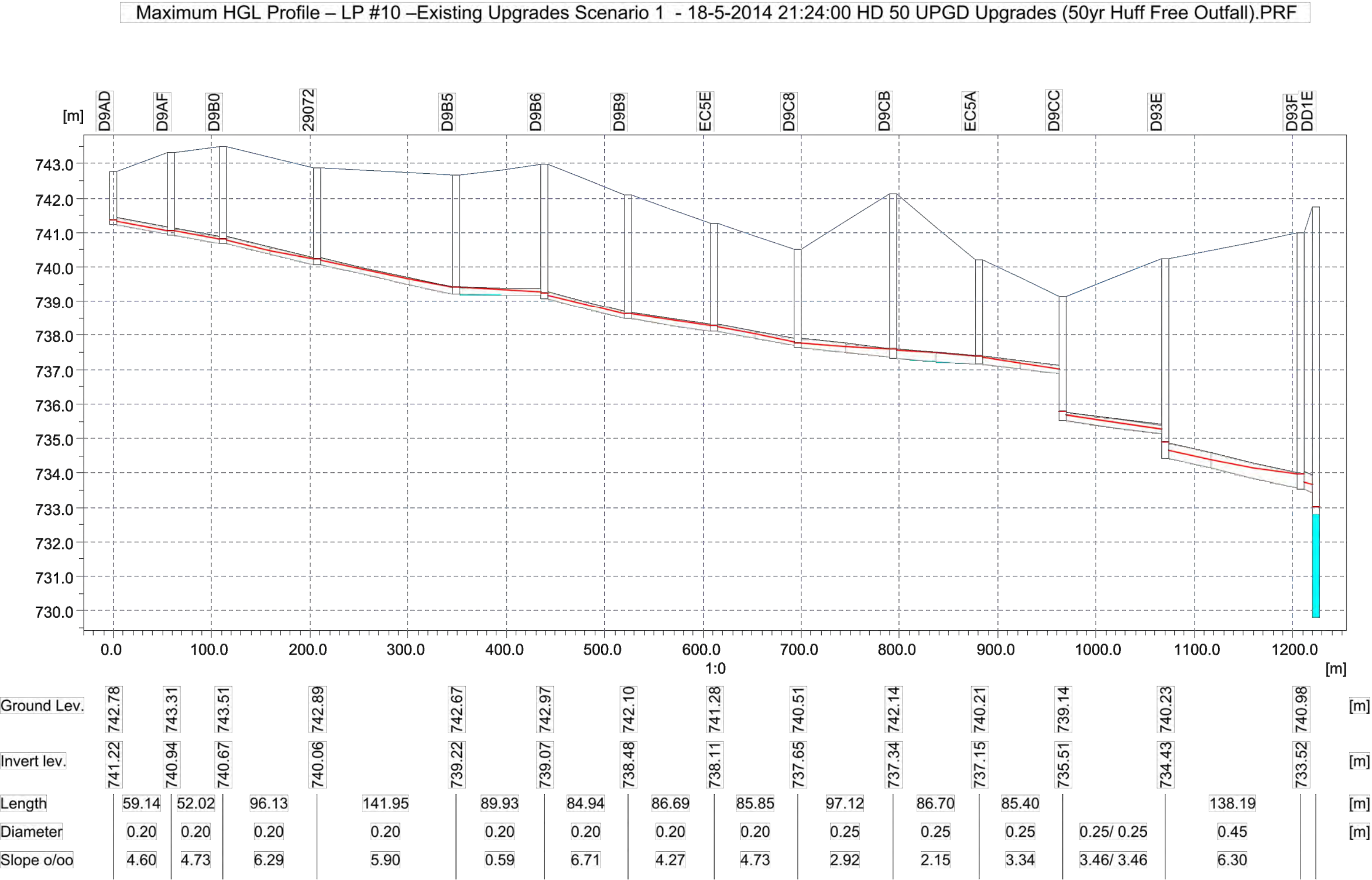
FIGURE 7.4.10



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #9**

FIGURE 7.4.11

RAFAL\_JADZINSKI Apr. 7, 15 11:05:07 AM N: 26000\26031\_REDCLIFF\_SANITARY\_11\_JJJ\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (NW LS & MC SEWER FIXED)\26031\_MAX HGL PROFILES -UPGRADES 50YR 24HR HUFF Q4 STORM (NW LS & MC LINE FIXED).DWG



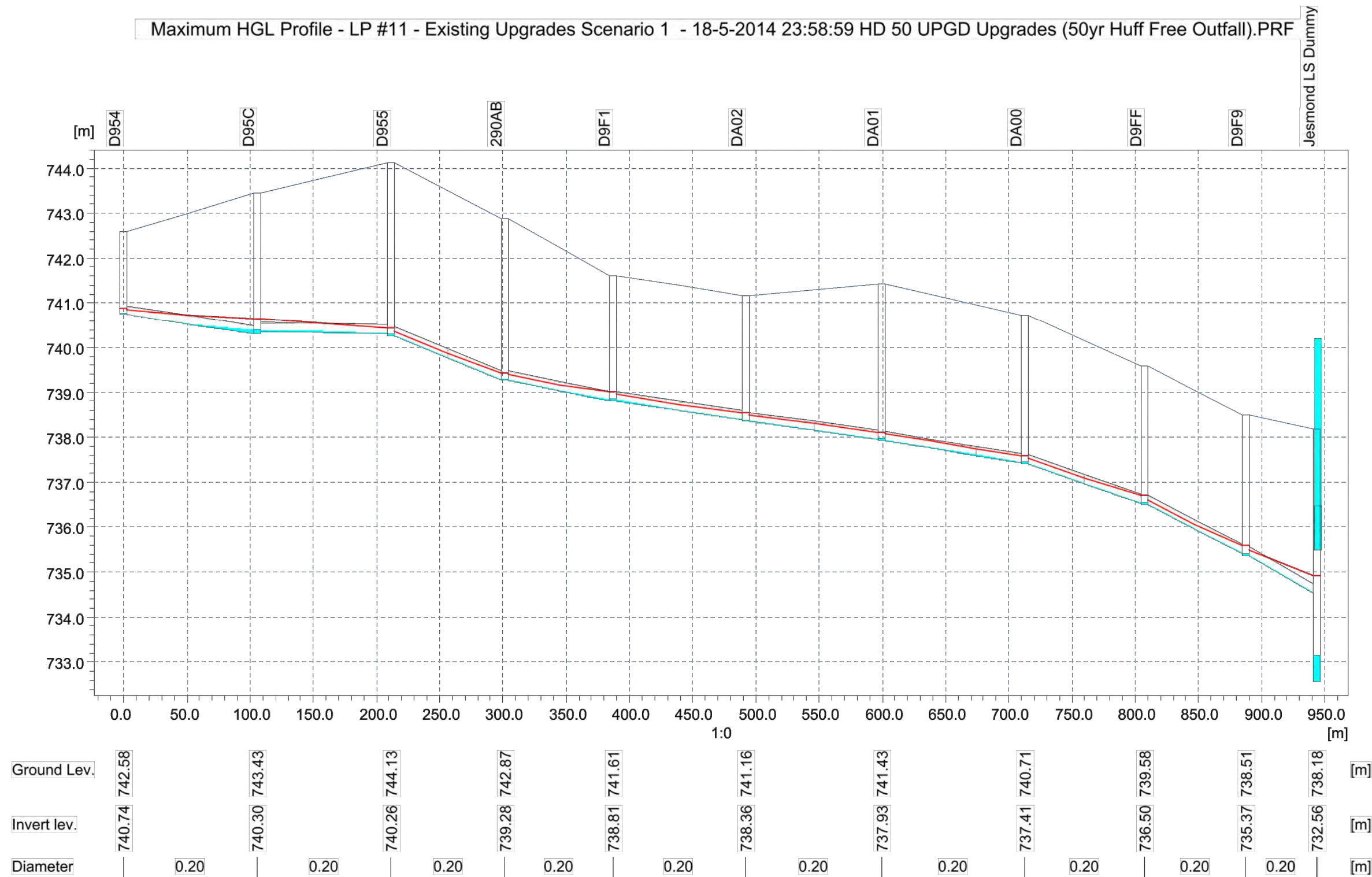


TOWN OF REDCLIFF  
SANITARY I-I STUDY  
EXISTING SYSTEM WITH UPGRADES  
MEDICINE HAT SEWER UPGRADED  
MAXIMUM HGL PROFILE #10



279

FIGURE 7.4.12



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE #11**



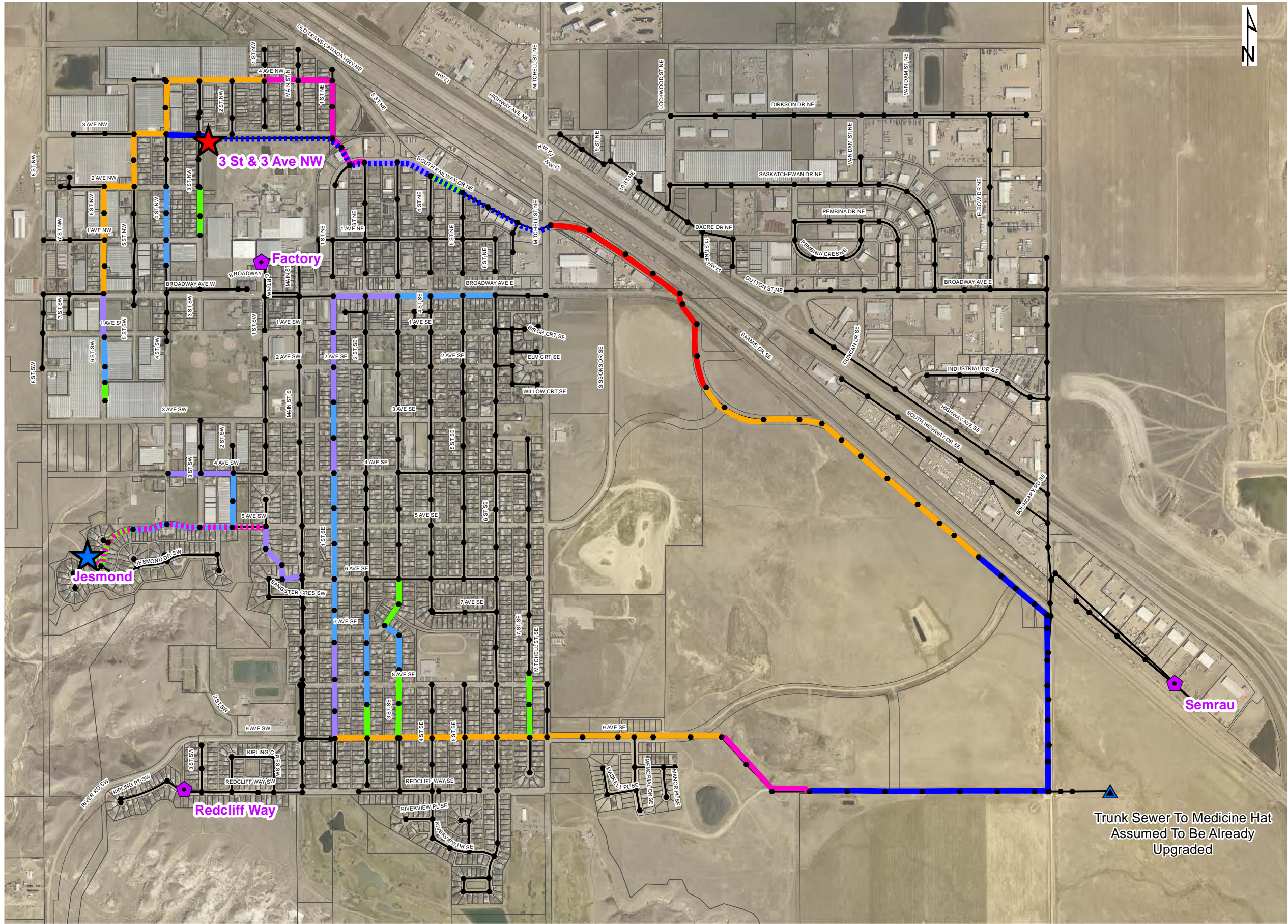


FIGURE 7.5

## Legend

### Sanitary Gravity Trunk

- Proposed Twin 200mm
- Proposed Twin 250mm
- Proposed Twin 300mm
- Proposed Twin 375mm
- Proposed Twin 450mm
- Proposed Twin 525mm
- Proposed Twin 675mm

### Sanitary Forcemain

- Proposed Twin 250mm
- Proposed Twin 525mm

### Proposed Lift Station

- New Capacity of 560L/s
- New Capacity of 80L/s
- Existing Lift Station
- Existing Sanitary Trunk

1:12,500

0 50 100 200 300 400 Meters



## TOWN OF REDCLIFF SANITARY I-I STUDY

CONCEPTUAL UPGRADES  
(WITH SEWER TO MEDICINE HAT UPSIZED)  
EXISTING SYSTEM PLUS  
JULY 6, 2013 THUNDERSTORM





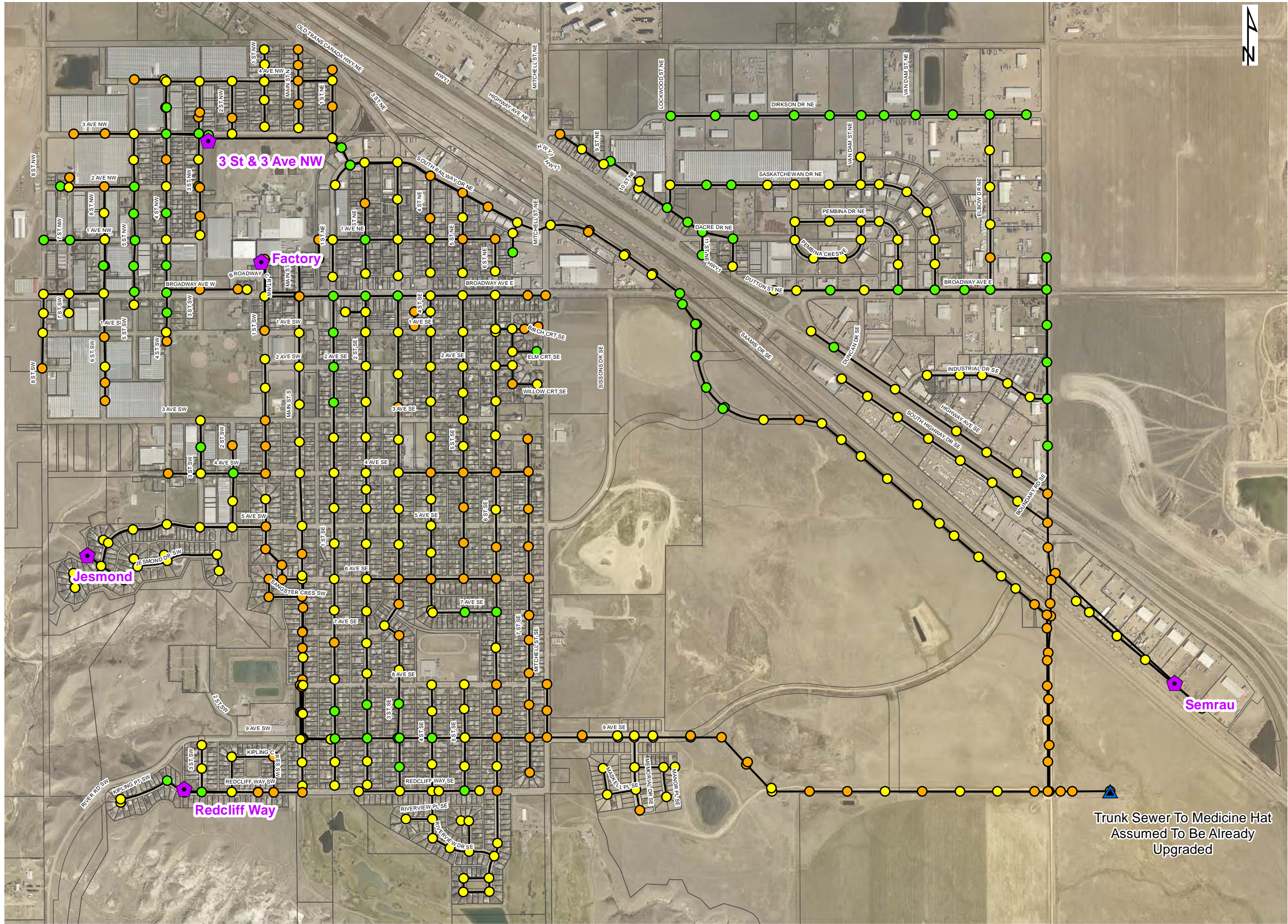
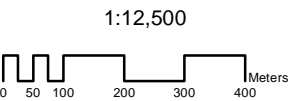


FIGURE 7.6

Legend

- Less Than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and -0.50m
- Greater Than 0.00m
- Sanitary Trunk
- Lift Station



TOWN OF REDCLIFF  
SANITARY I-I STUDY

PEAK HGL RELATIVE TO GROUND  
UPGRADED EXISTING SYSTEM WITH  
MEDICINE HAT SEWER UPSIZED  
PLUS JULY 6 2013 THUNDERSTORM





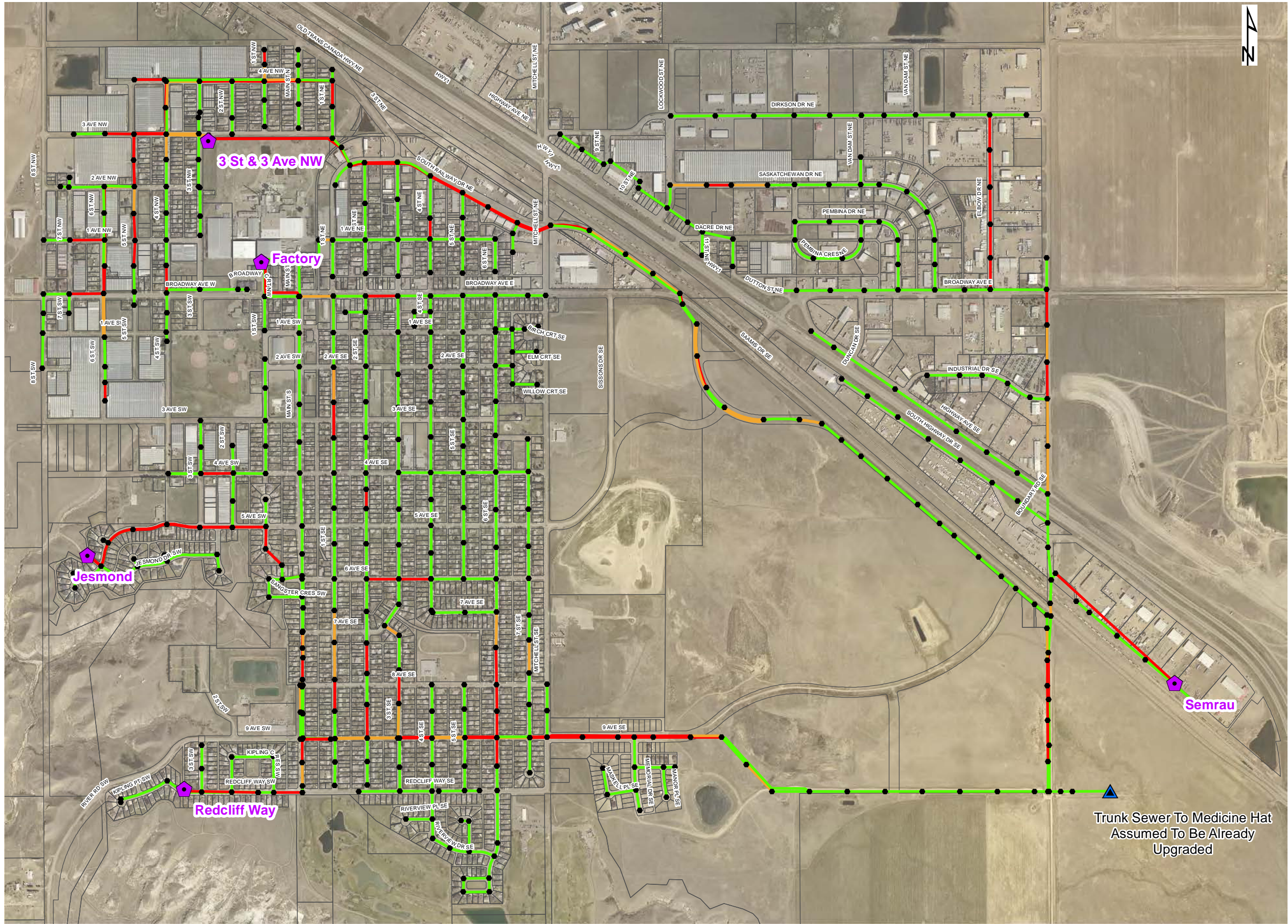
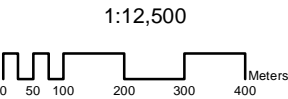


FIGURE 7.7

Legend

- Greater Than 100%
- Between 86% and 100%
- Less Than 86%
- Lift Station

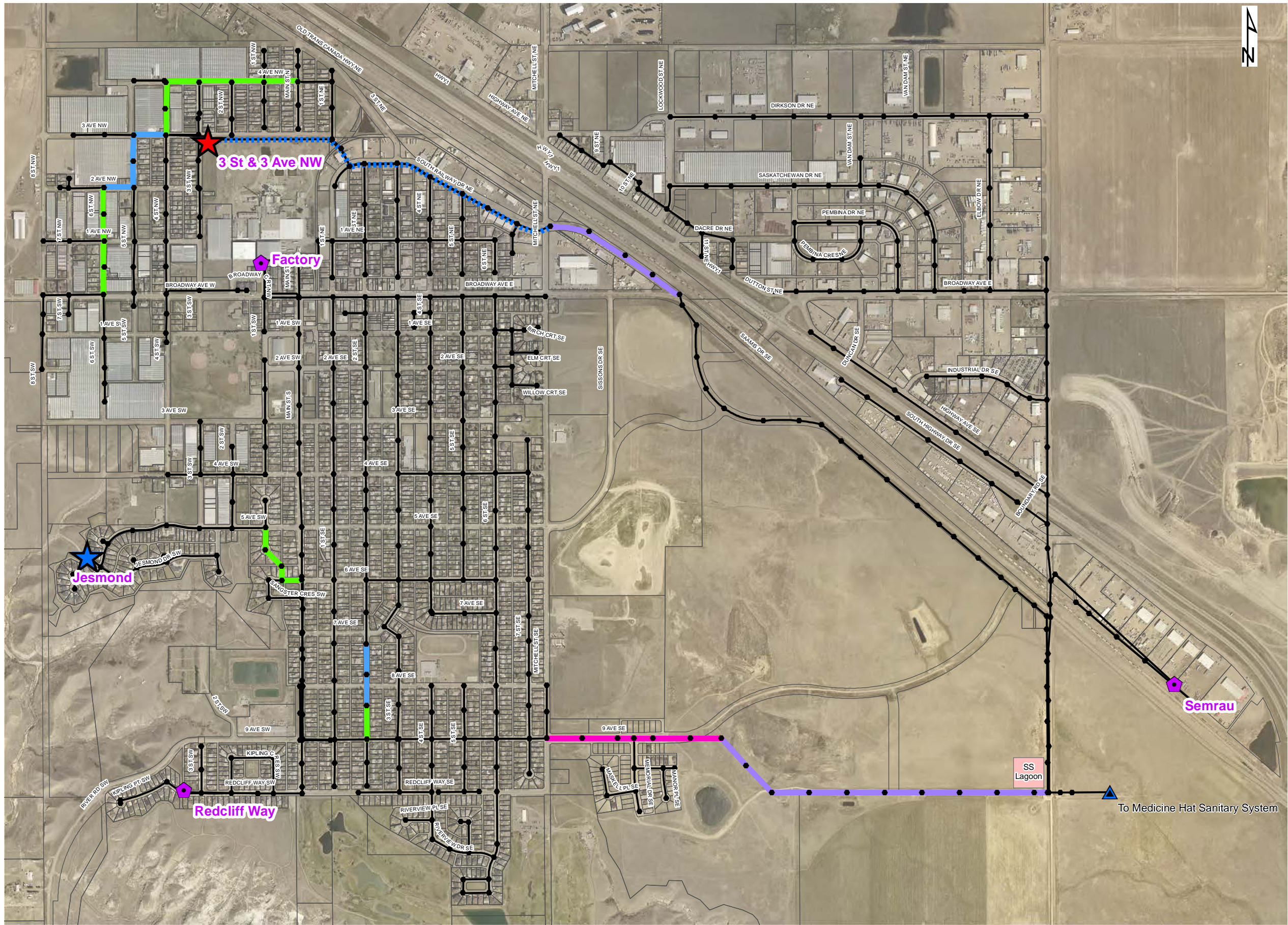


TOWN OF REDCLIFF  
SANITARY I-I STUDY  
PEAK DISCHARGE RELATIVE TO PIPE CAPACITY  
UPGRADED EXISTING SYSTEM WITH  
MEDICINE HAT SEWER UPSIZED  
PLUS JULY 6 2013 THUNDERSTORM





FIGURE 7.8



## Legend

### Sanitary Gravity Trunk

- Proposed Twin 200mm
- Proposed Twin 250mm
- Proposed Twin 300mm
- Proposed Twin 375mm

### Sanitary Forcemain

- Proposed Twin 250mm

### Proposed Lift Station

- New Capacity of 167L/s
- New Active Storage of 60.5 cu.m & New Capacity of 33.1L/s
- Existing Lift Station
- Surcharge Suppression Lagoon. Maximum Footprint of 9,700 sq.m
- Existing Sanitary Trunk

1:12,500



## TOWN OF REDCLIFF SANITARY I-I STUDY

CONCEPTUAL UPGRADES  
(WITH SS LAGOON)  
EXISTING SYSTEM PLUS  
50YR 24HR HUFF Q4 STORM





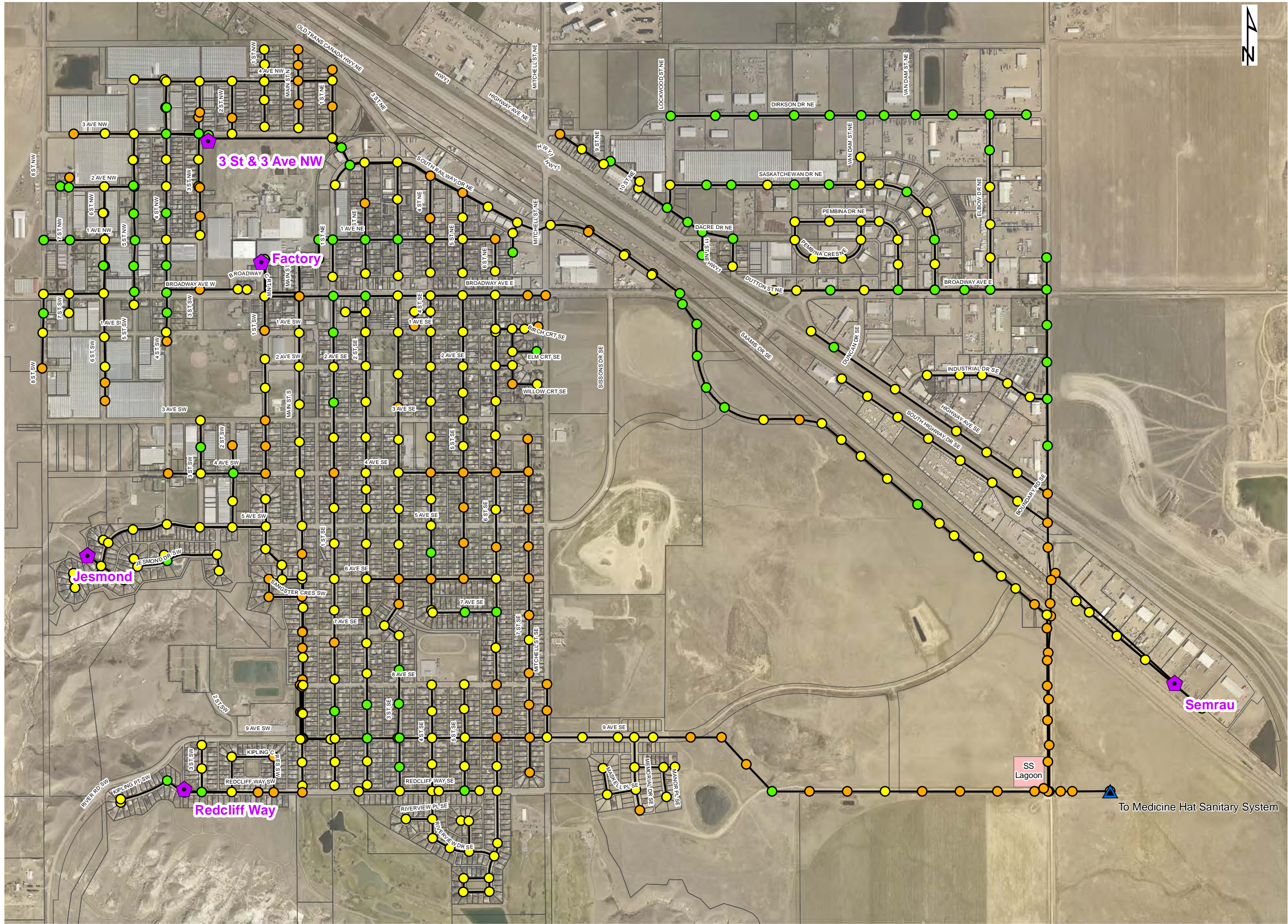
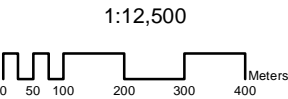


FIGURE 7.9

Legend

- Less Than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and -0.50m
- Greater Than 0.00m
- Lift Station
- Surcharge Suppression Lagoon. Maximum Footprint of 9,700 sq.m
- Sanitary Trunk



TOWN OF REDCLIFF  
SANITARY I-H STUDY

PEAK HGL RELATIVE TO GROUND  
UPGRADED EXISTING SYSTEM WITH  
SURCHARGE SUPPRESSION LAGOON  
PLUS 50YR 24HR HUFF Q4 STORM





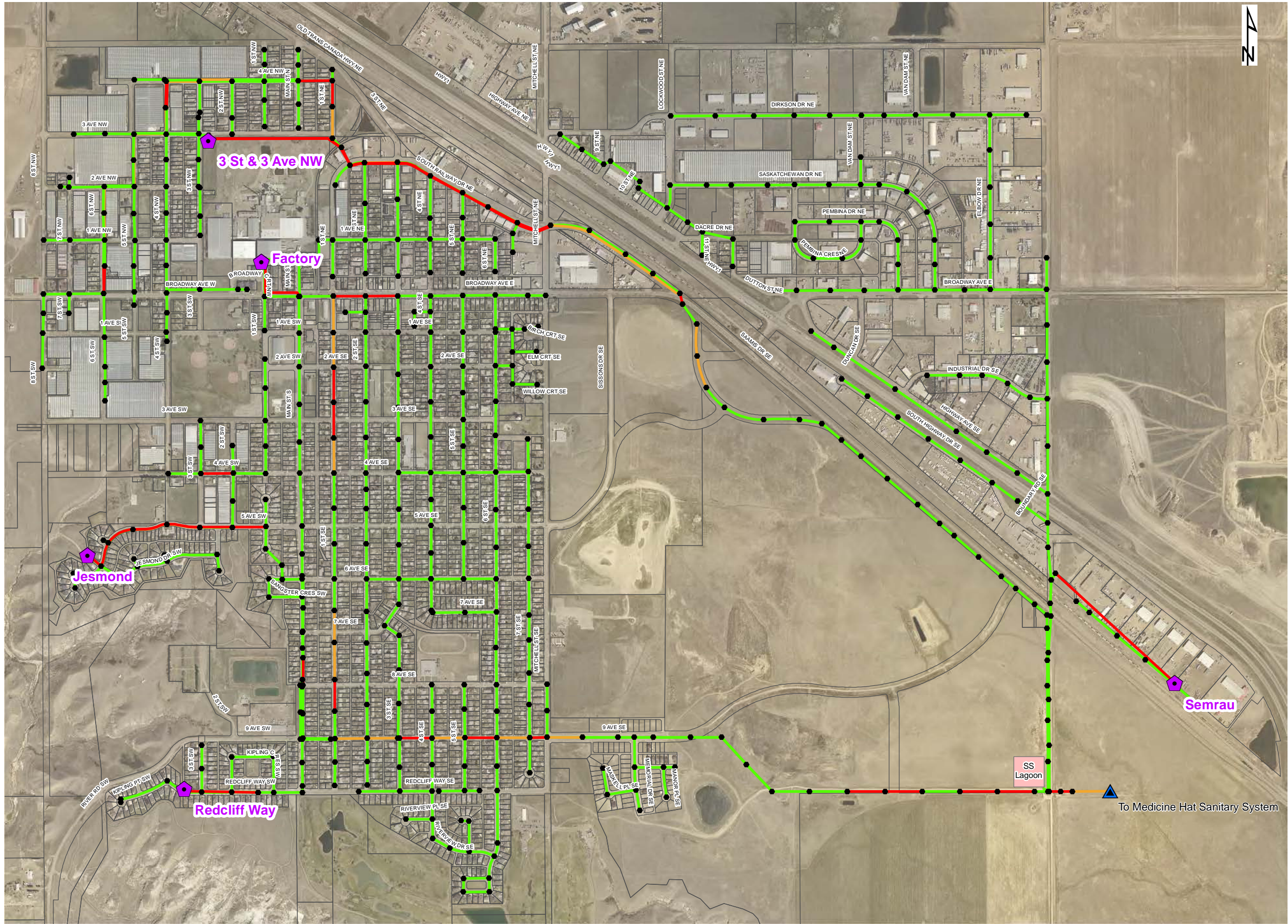
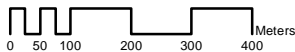


FIGURE 7.10

Legend

- Greater Than 100%
- Between 86% and 100%
- Less Than 86%
- Lift Station
- Surcharge Suppression Lagoon. Maximum Footprint of 9,700 sq.m

1:12,500



TOWN OF REDCLIFF  
SANITARY I-I STUDY

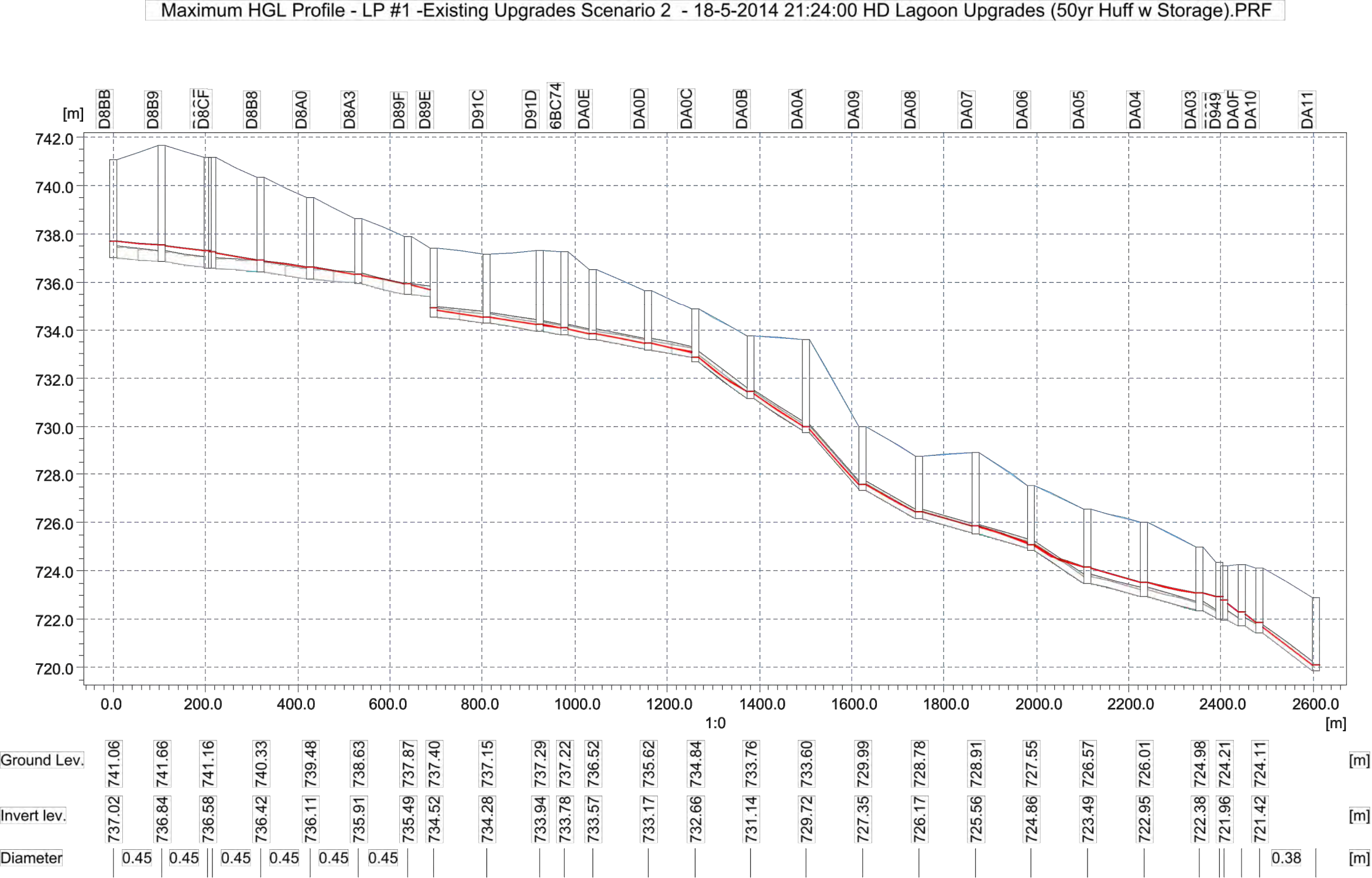
PEAK DISCHARGE RELATIVE TO PIPE CAPACITY  
UPGRADED EXISTING SYSTEM WITH  
SURCHARGE SUPPRESSION LAAGOON  
PLUS 50YR 24HR HUFF Q4 STORM







FIGURE 7.11.1

RAFAL JADZINSKI Apr. 7, 15 11:01:23 AM N:\26000\26031\_REDCLIFF\_SANITARY\J\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (SS LAGOON)\26031\_MAX HGL PROFILES -UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON).DWG



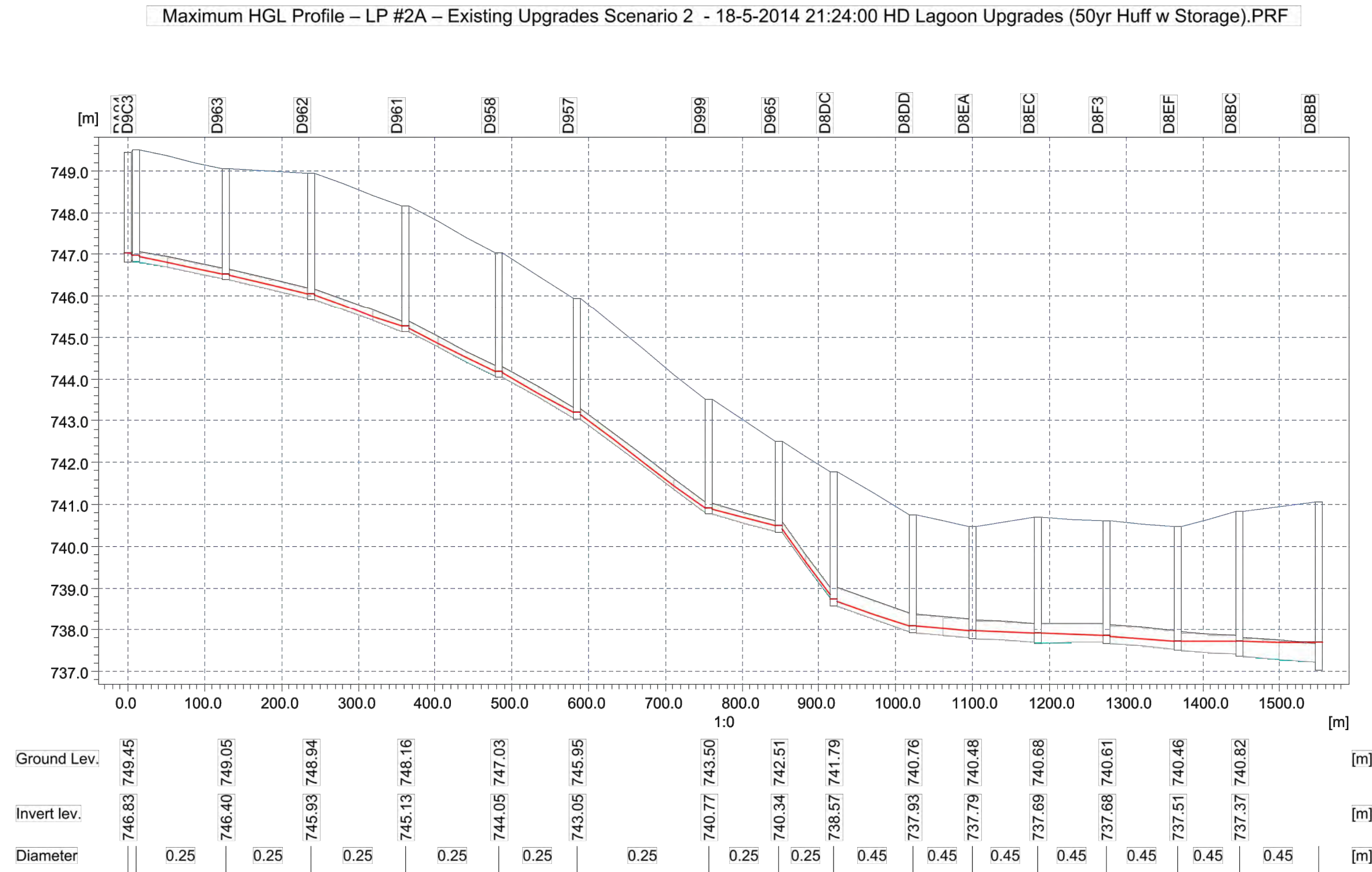


TOWN OF REDCLIFF  
SANITARY H STUDY  
EXISTING SYSTEM WITH UPGRADES  
SS LAGOON AS AN OVERFLOW STORAGE  
MAXIMUM HGL PROFILE - LP #1



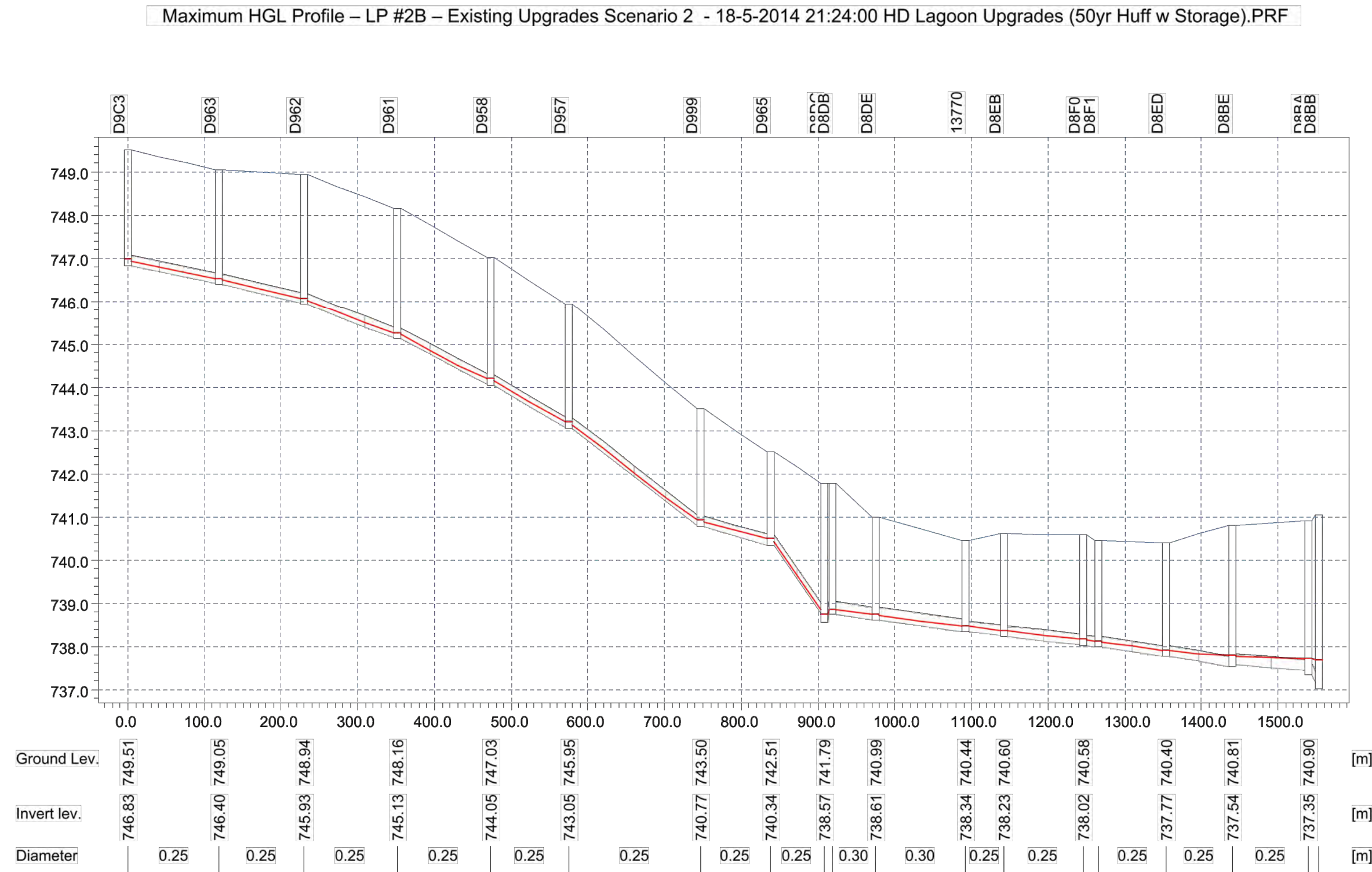
287

FIGURE 7.11.2



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**SS LAGOON AS AN OVERFLOW STORAGE**  
**MAXIMUM HGL PROFILE - LP #2A**

FIGURE 7.11.3



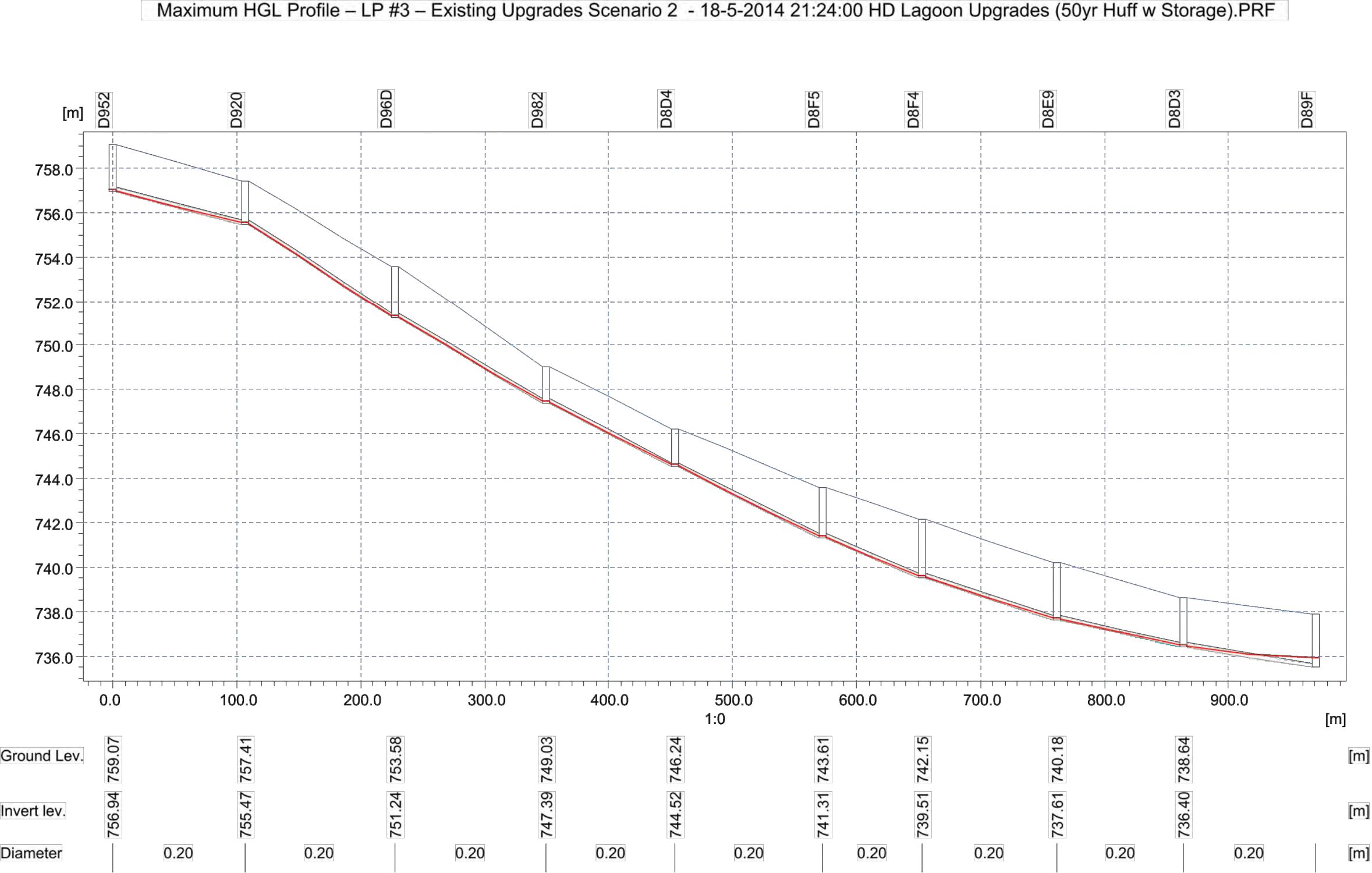
**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**SS LAGOON AS AN OVERFLOW STORAGE**  
**MAXIMUM HGL PROFILE - LP #2B**

RAFAL JADZINSKI Apr. 7, 15 11:01:25 AM N:\26000\26031\_REDCLIFF\_SANITARY\_H\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (SS LAGOON)\26031\_MAX HGL PROFILES -UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON).DWG



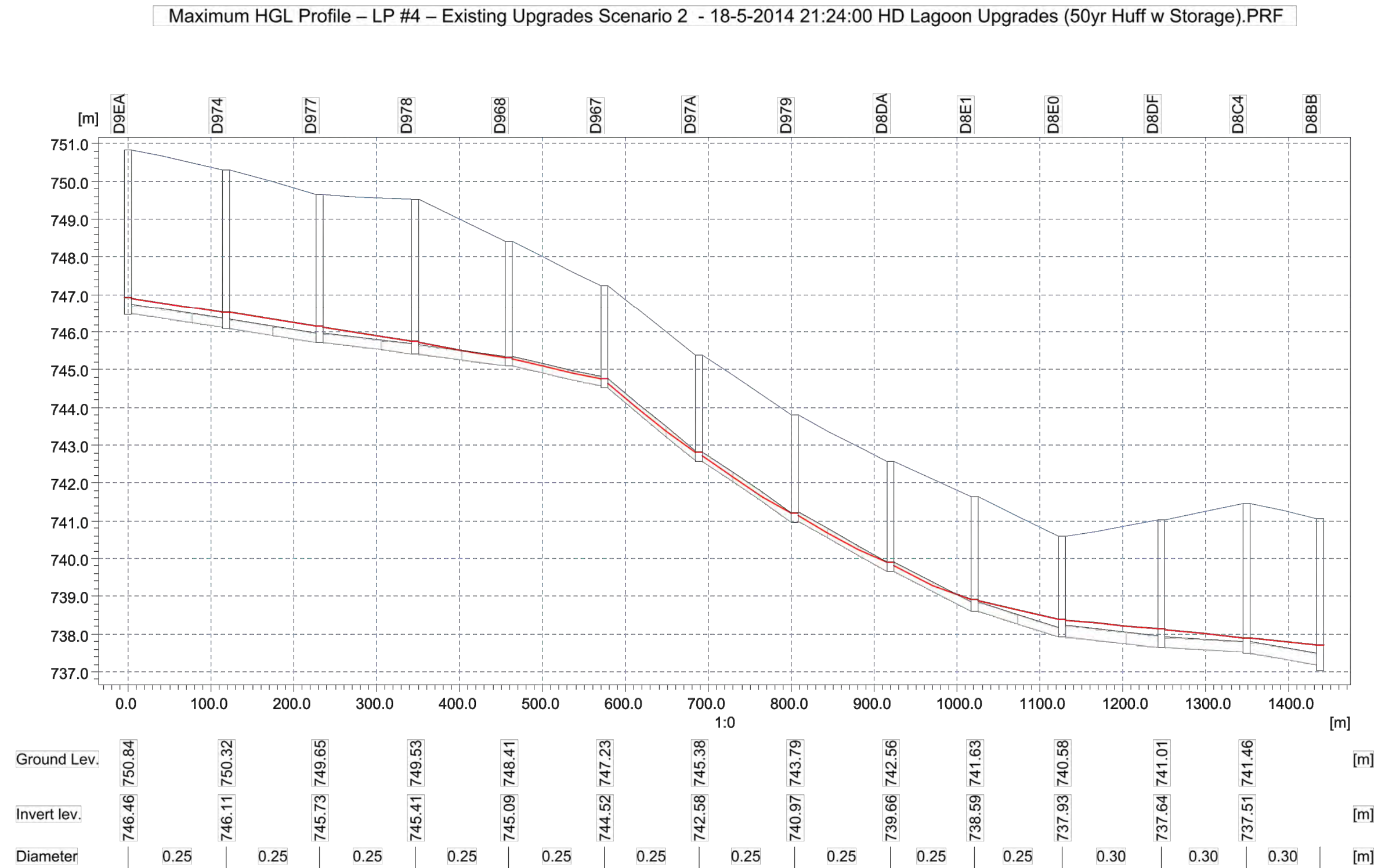
FIGURE 7.11.4

RAFAL JADZINSKI Apr. 7, 15 11:01:26 AM N:\26000\26031\_REDCLIFF\_SANITARY\J\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (SS LAGOON)\26031\_MAX HGL PROFILES -UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON).DWG



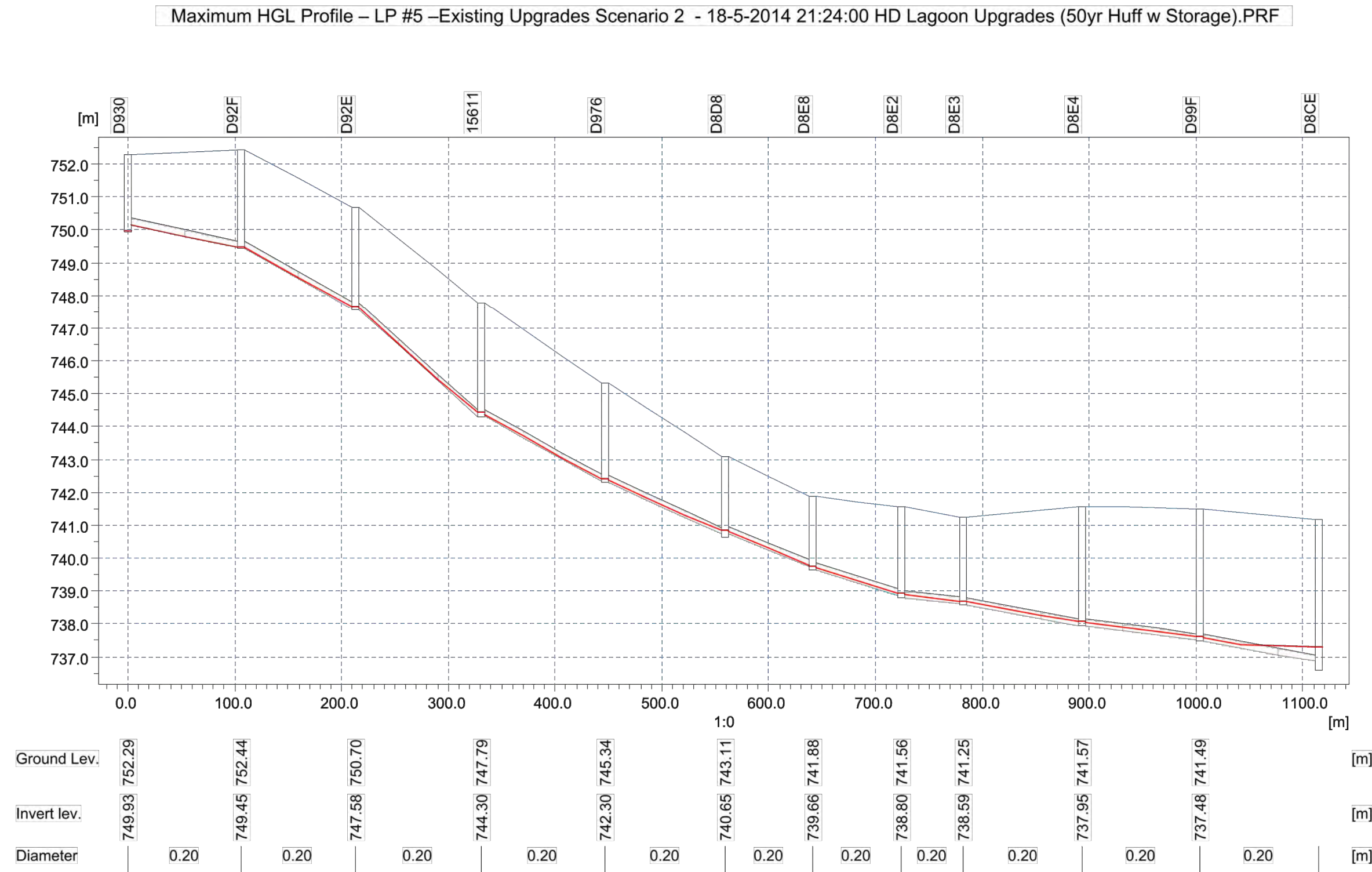
**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**SS LAGOON AS AN OVERFLOW STORAGE**  
**MAXIMUM HGL PROFILE - LP #3**

FIGURE 7.11.5



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**SS LAGOON AS AN OVERFLOW STORAGE**  
**MAXIMUM HGL PROFILE - LP #4**

FIGURE 7.11.6



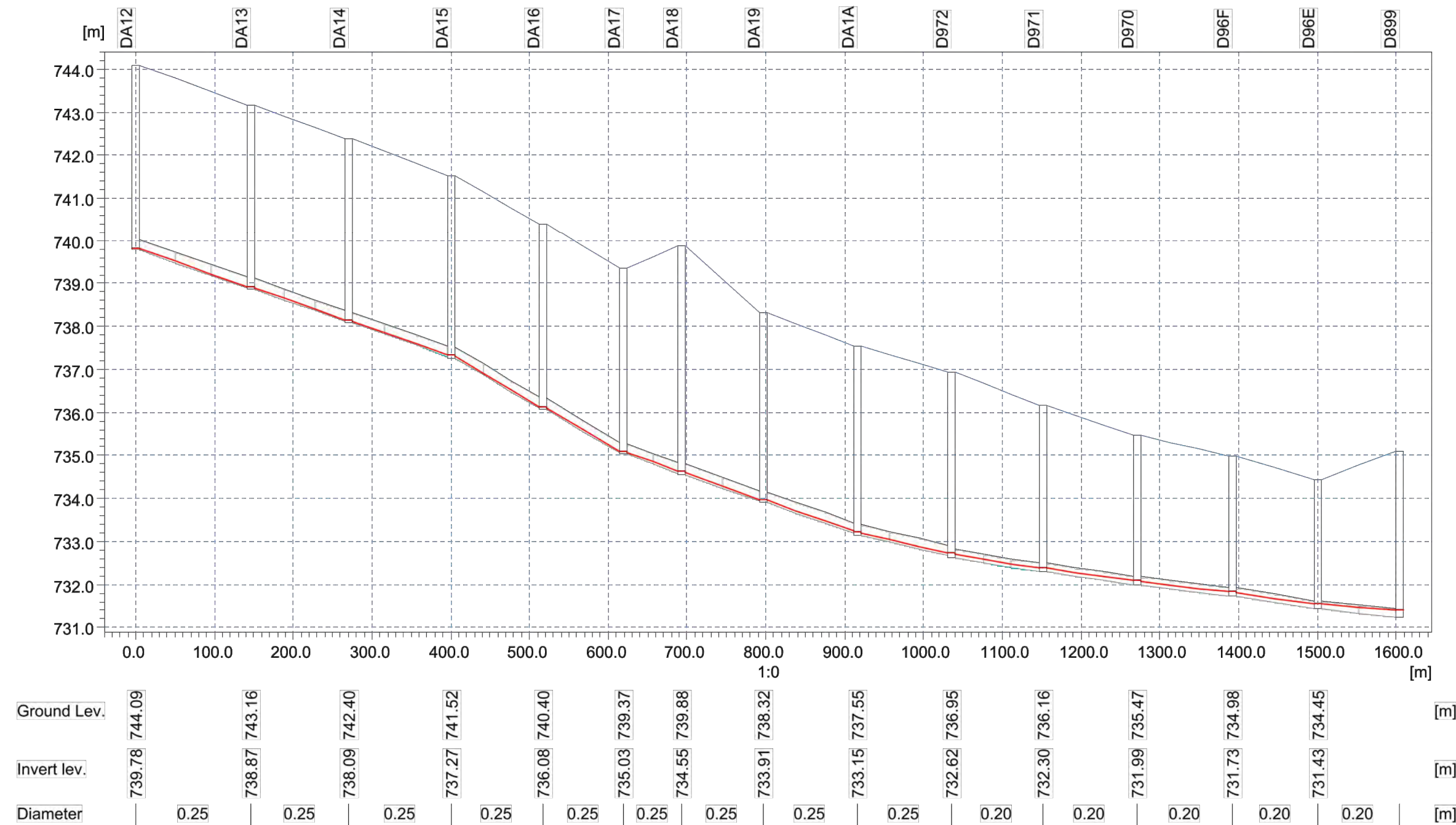
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**SS LAGOON AS AN OVERFLOW STORAGE**  
**MAXIMUM HGL PROFILE - LP #5**





FIGURE 7.11.7

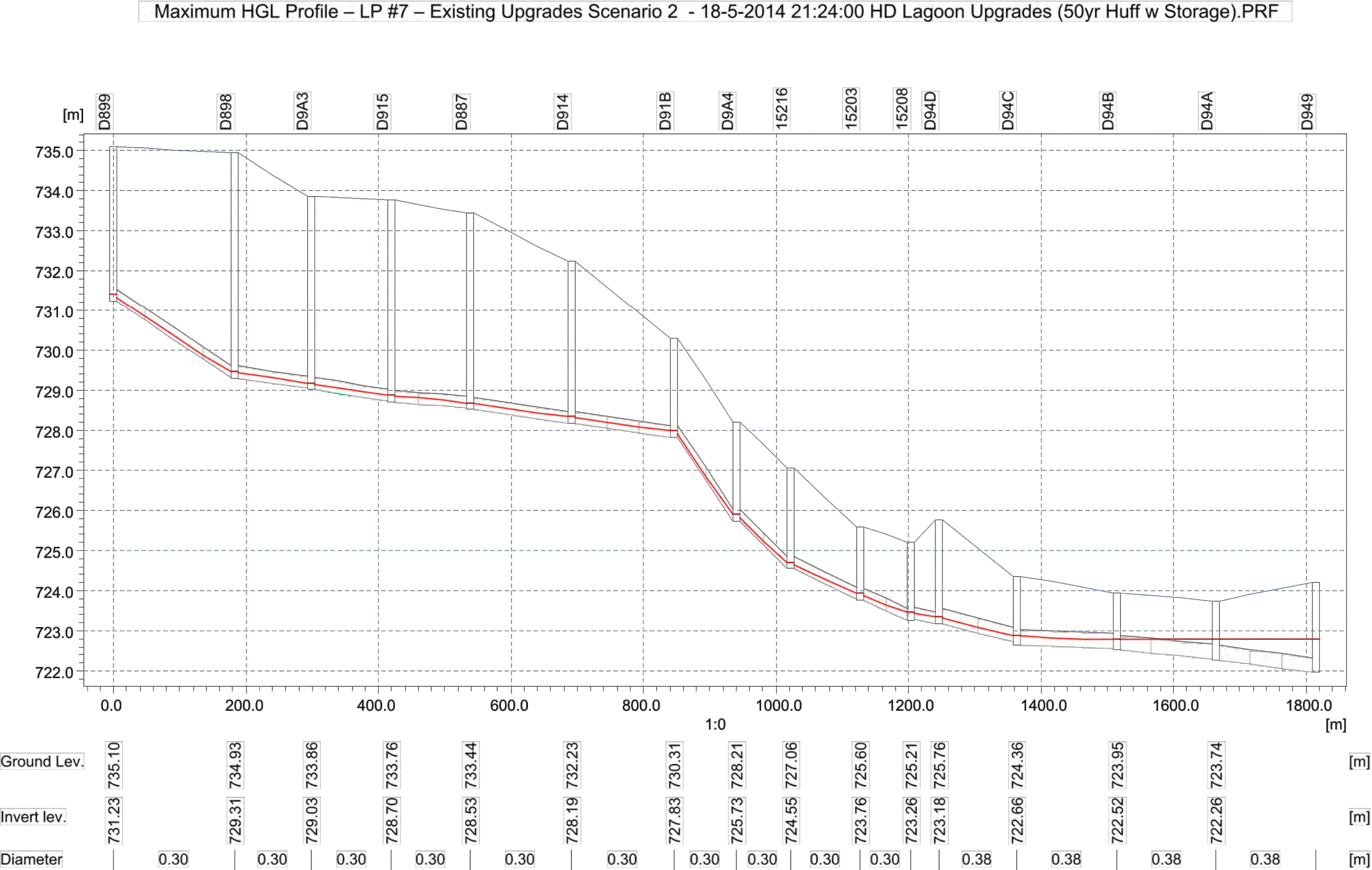
Maximum HGL Profile – LP #6 – Existing Upgrades Scenario 2 - 18-5-2014 21:24:00 HD Lagoon Upgrades (50yr Huff w Storage).PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**SS LAGOON AS AN OVERFLOW STORAGE**  
**MAXIMUM HGL PROFILE - LP #6**

FIGURE 7.11.8

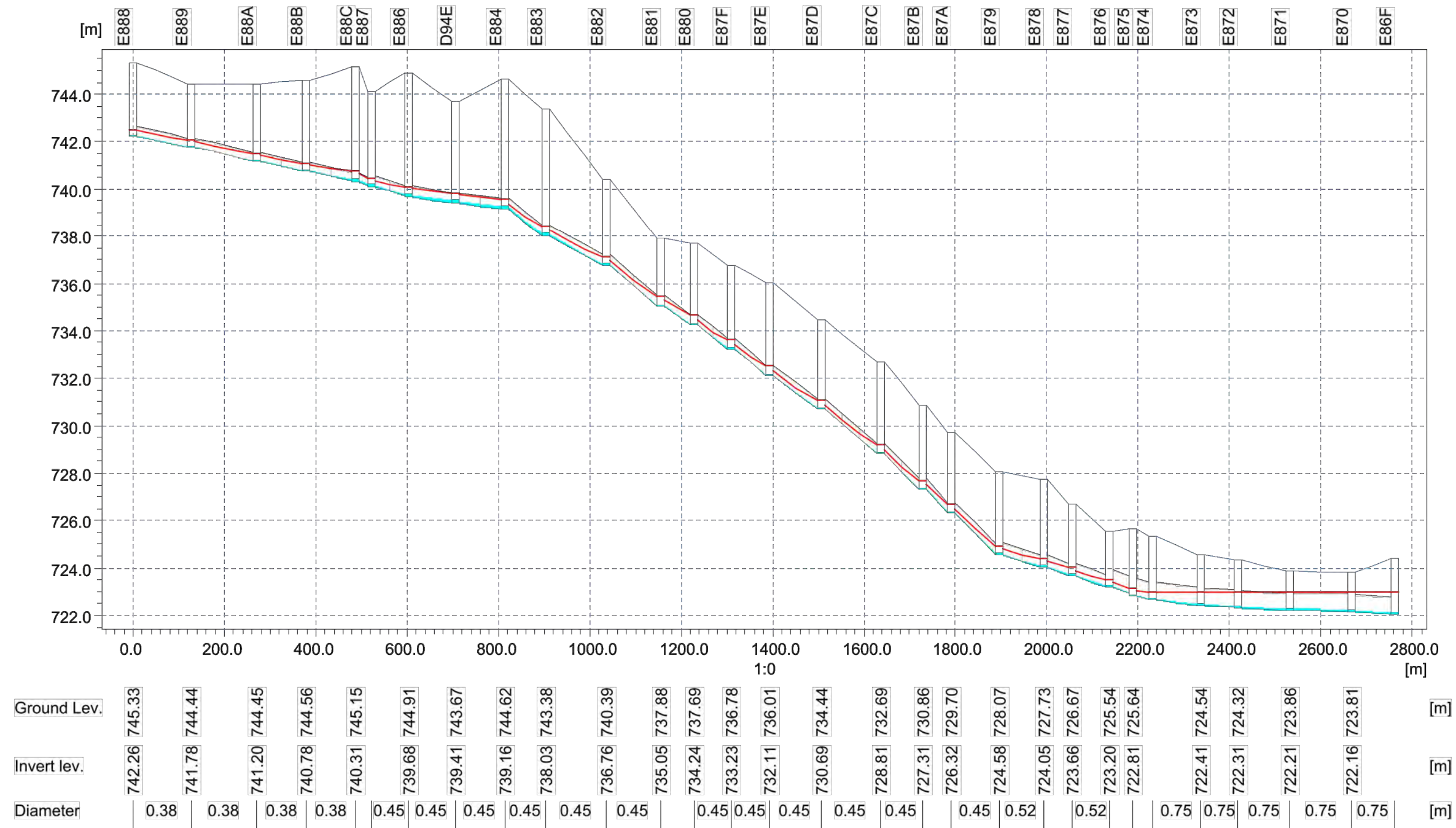
RAFAL JADZINSKI Apr. 7, 15 11:01:30 AM N:\26000\26031\_REDCLIFF\_SANITARY\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (SS LAGOON)\26031\_MAX HGL PROFILES -UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON).DWG



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**SS LAGOON AS AN OVERFLOW STORAGE**  
**MAXIMUM HGL PROFILE - LP #7**

FIGURE 7.11.9

Maximum HGL Profile - LP #8 - Existing Upgrades Scenario 2 - 18-5-2014 23:59:20 HD Lagoon Upgrades (50yr Huff w Storage).PRF

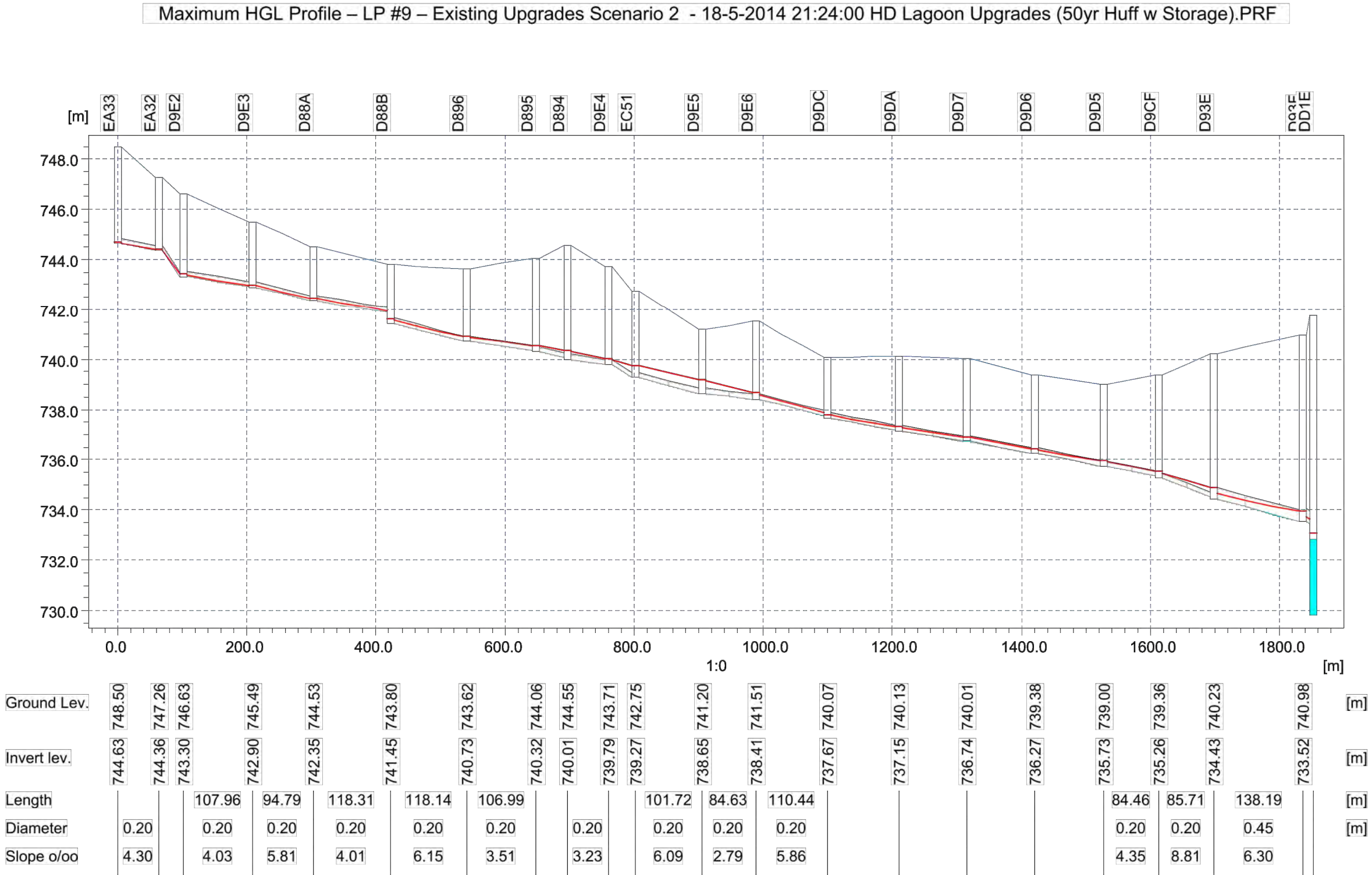



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**SS LAGOON AS AN OVERFLOW STORAGE**  
**MAXIMUM HGL PROFILE - LP #8**




FIGURE 7.11.10

RAFAL JADZINSKI Apr. 7, 15 11:01:32 AM N:\26000\26031\_REDCLIFF\_SANITARY\_L\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (SS LAGOON)\26031\_MAX HGL PROFILES - UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON).DWG





TOWN OF REDCLIFF  
SANITARY H STUDY  
EXISTING SYSTEM WITH UPGRADES  
SS LAGOON AS AN OVERFLOW STORAGE  
MAXIMUM HGL PROFILE - LP #9

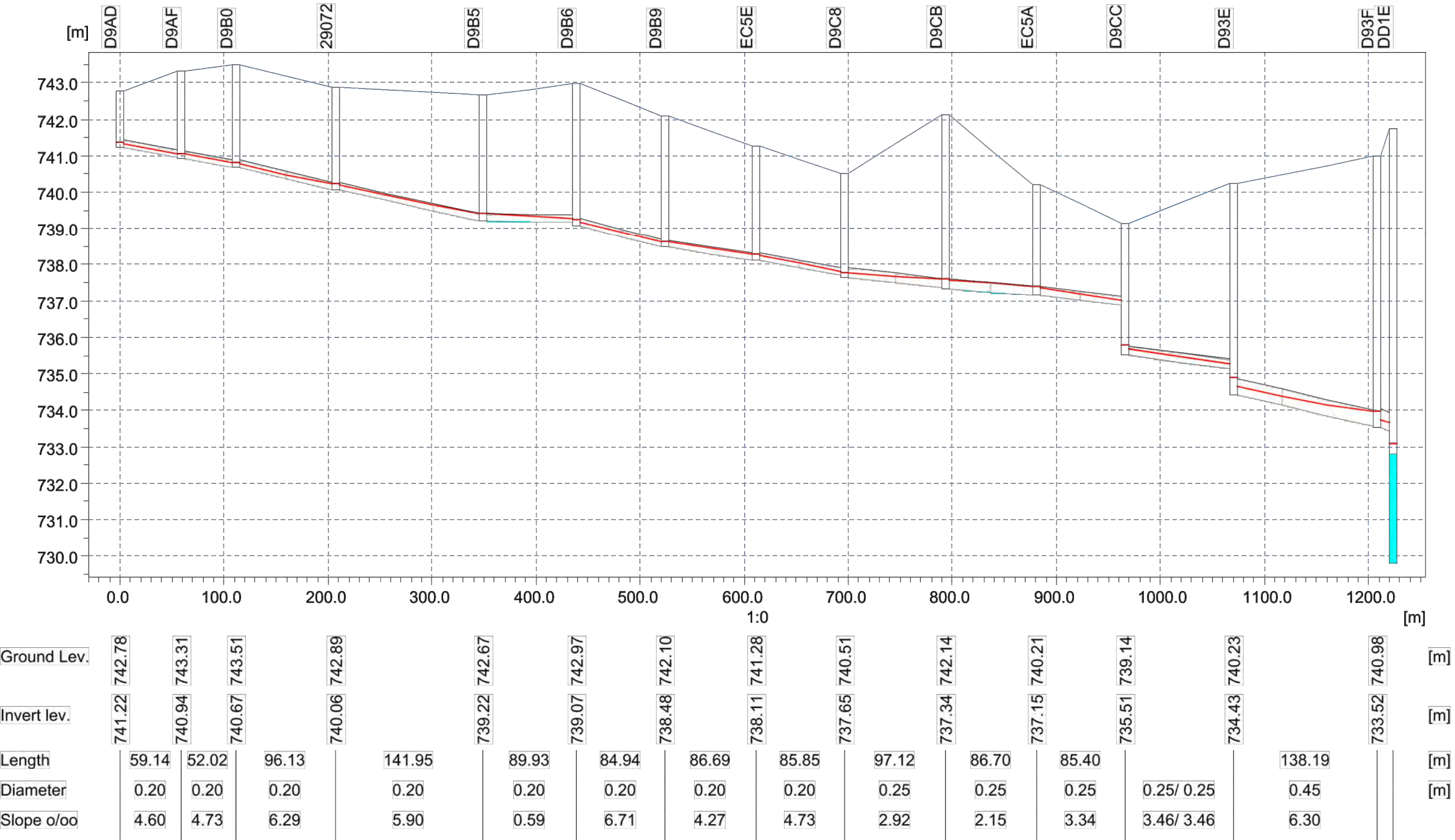


296

RAFAL JADZINSKI Apr. 7, 15 11:01:33 AM N:\26000\26031\_REDCLIFF\_SANITARY\J\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (SS LAGOON)\26031\_MAX HGL PROFILES - UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON).DWG

FIGURE 7.11.11

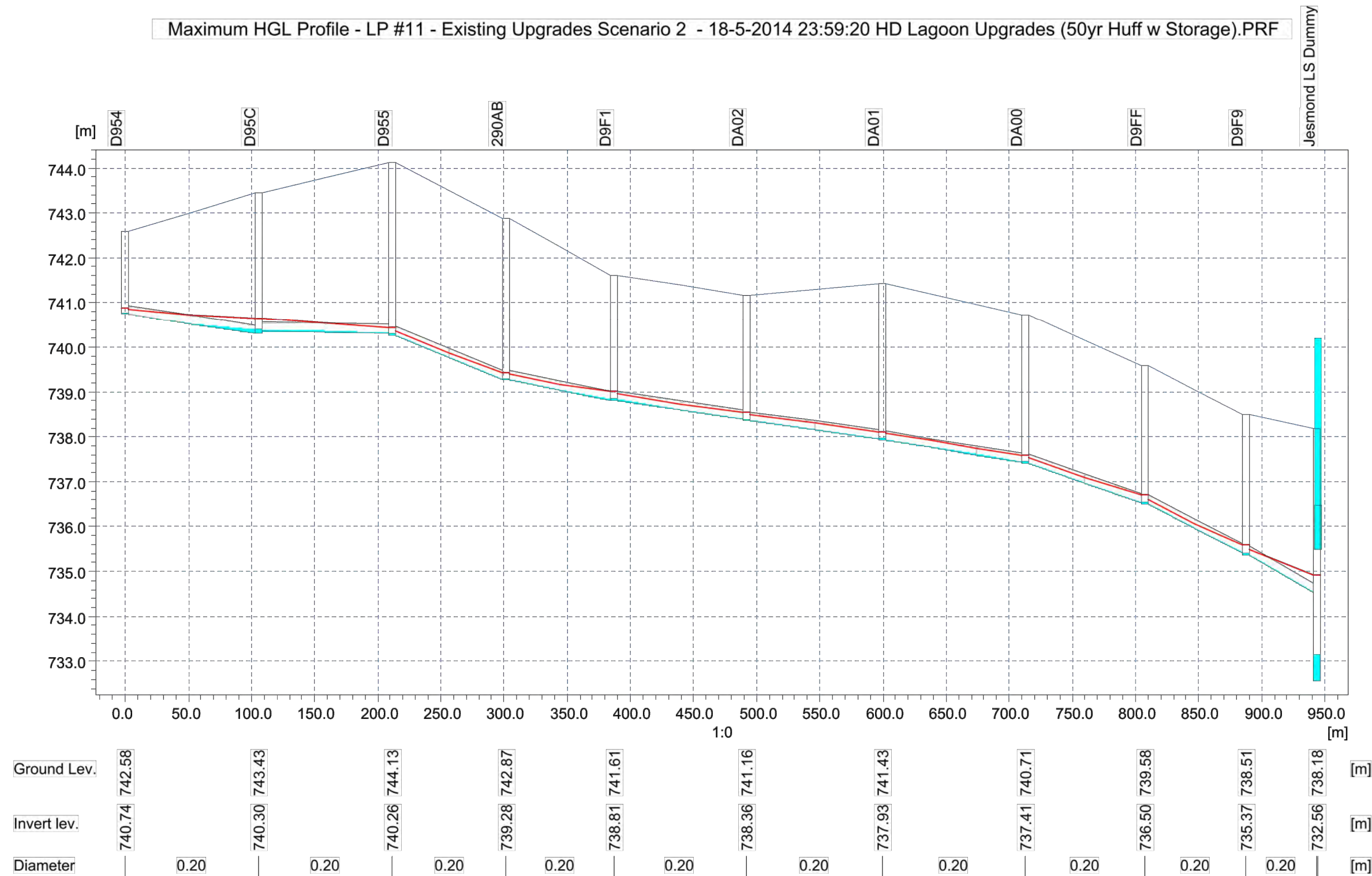
Maximum HGL Profile – LP #10 – Existing Upgrades Scenario 2 - 18-5-2014 21:24:00 HD Lagoon Upgrades (50yr Huff w Storage).PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**SS LAGOON AS AN OVERFLOW STORAGE**  
**MAXIMUM HGL PROFILE - LP #10**

FIGURE 7.11.12

RAFAL JADZINSKI Apr. 7, 15 11:01:34 AM N: 26000\26031\_REDCLIFF\_SANITARY\_J\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\EX UPGRADES - (SS LAGOON)\26031\_MAX HGL PROFILES -UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON).DWG



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**EXISTING SYSTEM WITH UPGRADES**  
**SS LAGOON AS AN OVERFLOW STORAGE**  
**MAXIMUM HGL PROFILE - LP #11**



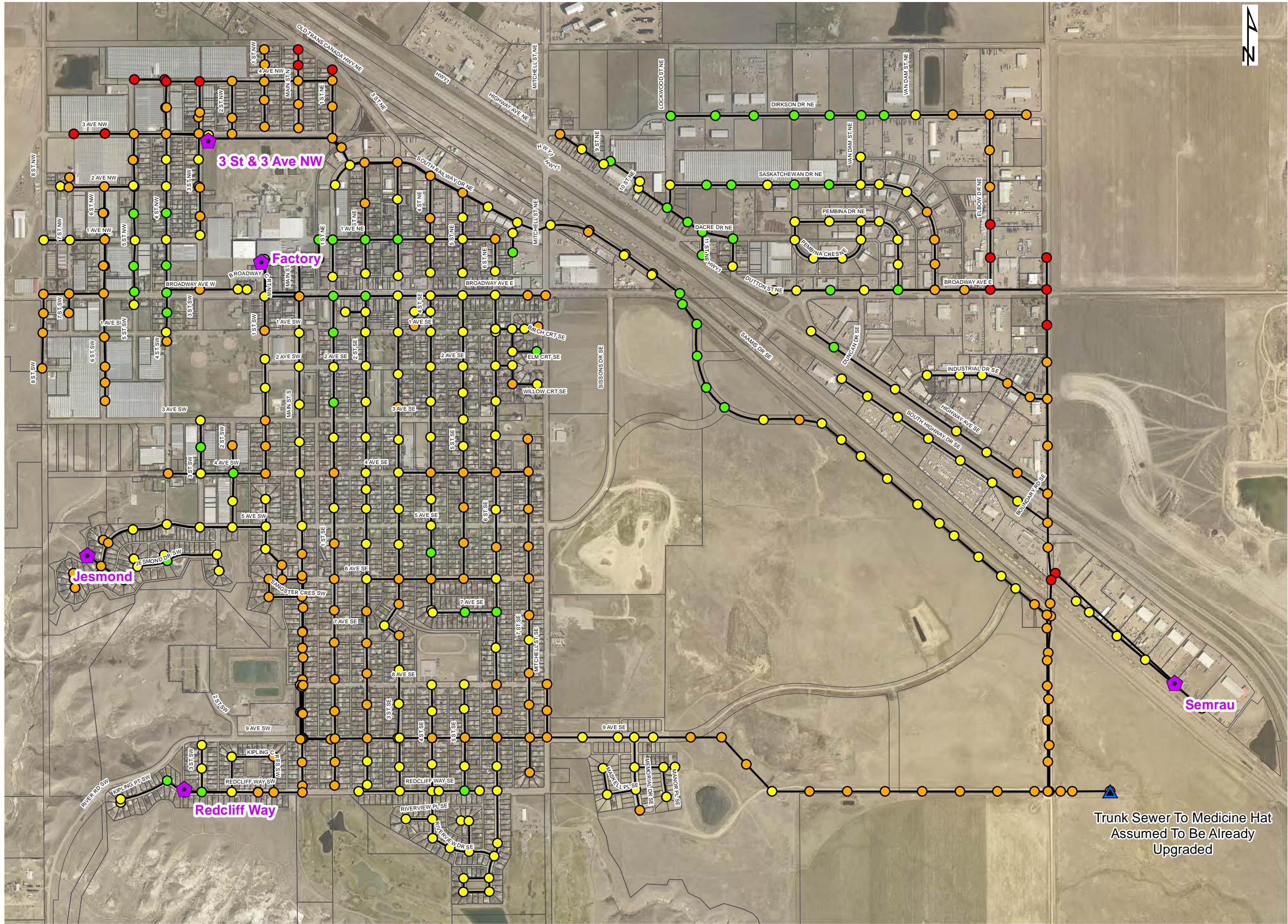
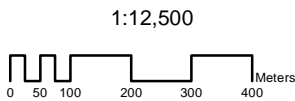


FIGURE 8.1

Legend

- Less Than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and -0.50m
- Greater Than 0.00m
- Sanitary Trunk
- ⬠ Lift Station



TOWN OF REDCLIFF  
SANITARY I-I STUDY

PEAK HGL RELATIVE TO GROUND  
FUTURE ASSESSMENT SCENARIO  
UPGRADED EXISTING SYSTEM  
PLUS 50YR HUFF Q4 STORM



Trunk Sewer To Medicine Hat  
Assumed To Be Already  
Upgraded





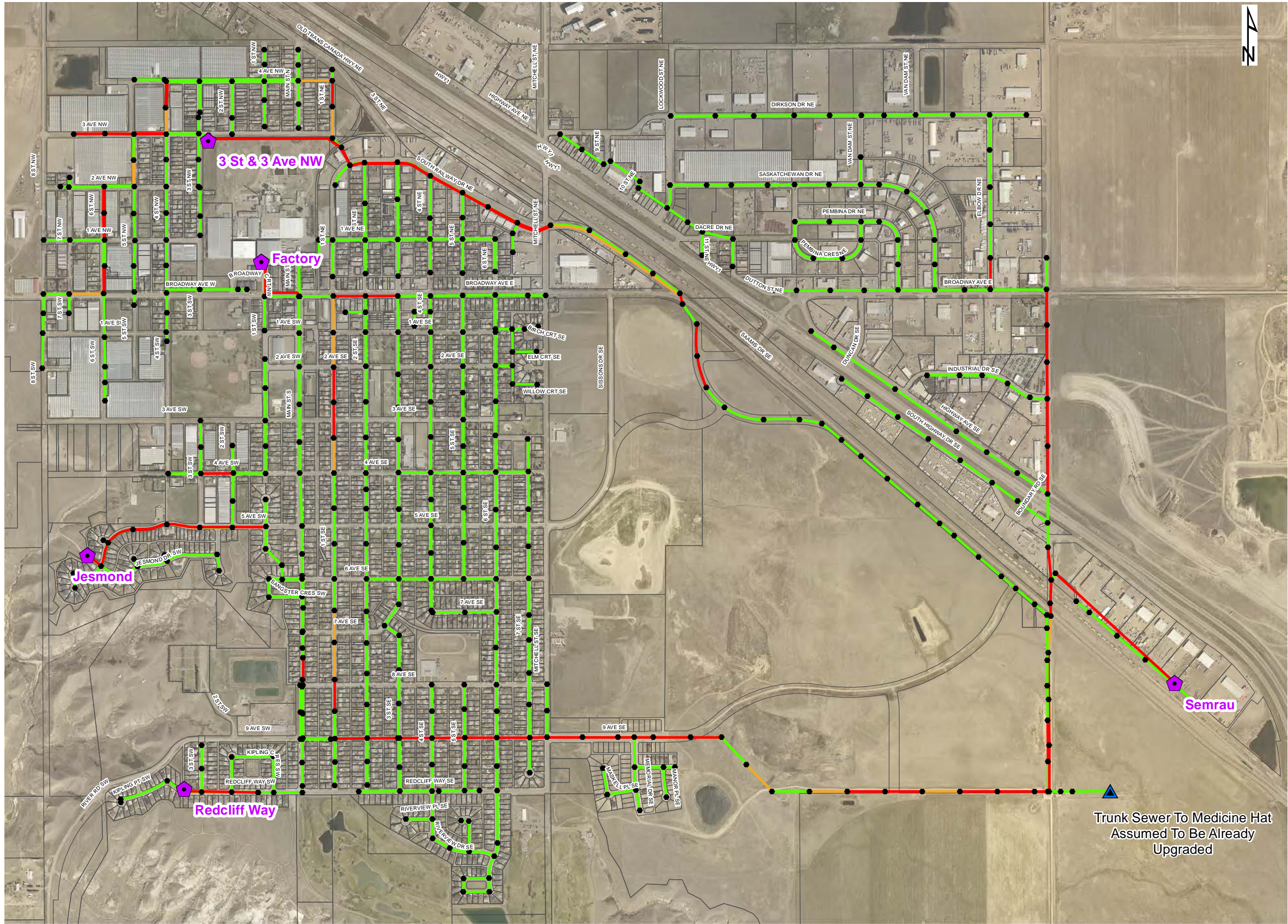
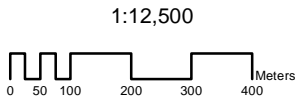


FIGURE 8.2

Legend

- Greater Than 100%
- Between 86% and 100%
- Less Than 86%
- Lift Station

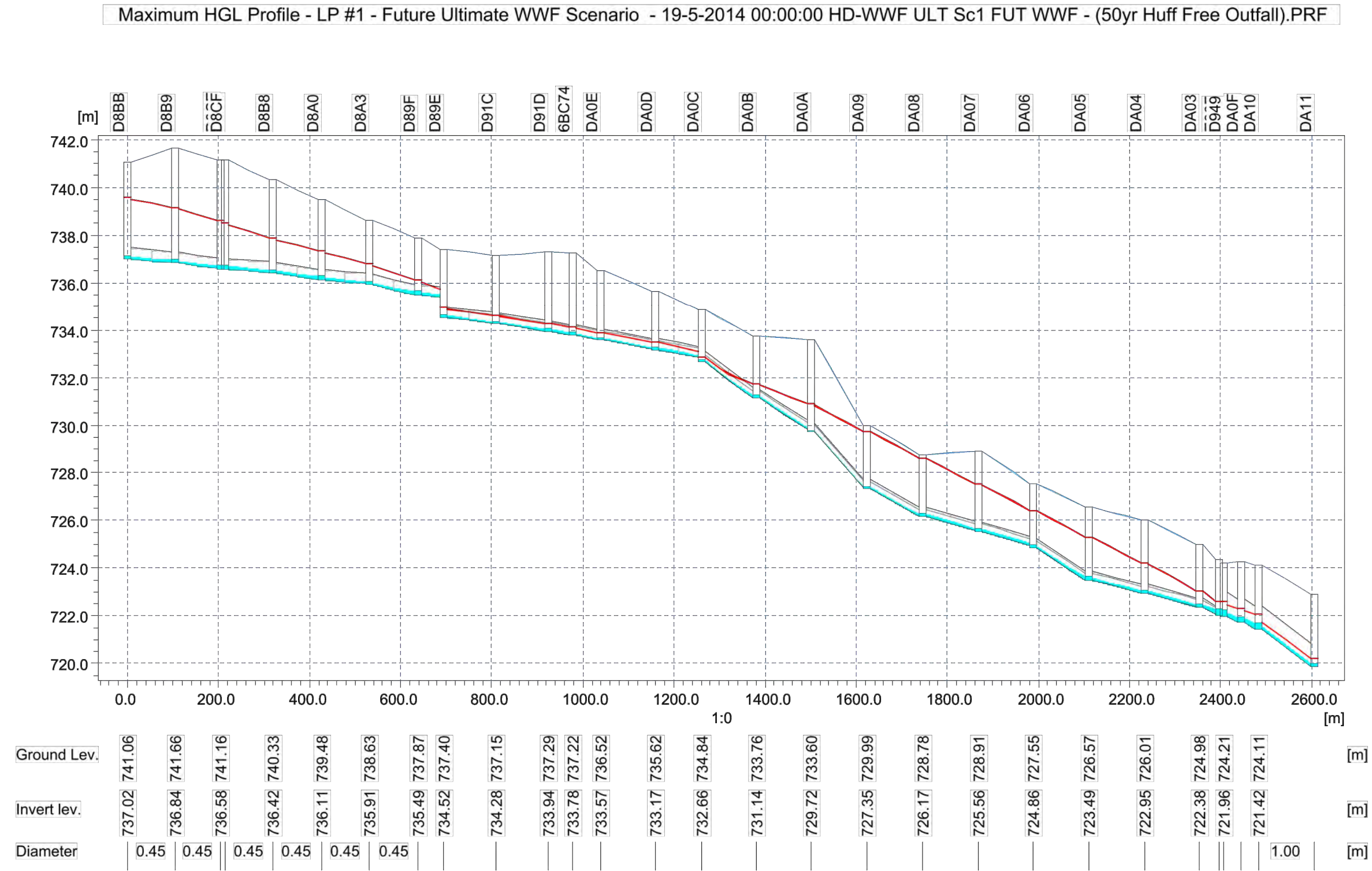


TOWN OF REDCLIFF  
SANITARY I-I STUDY  
PEAK DISCHARGE RELATIVE TO PIPE CAPACITY  
FUTURE ASSESSMENT SCENARIO  
UPGRADED EXISTING SYSTEM  
PLUS 50YR HUFF Q4 STORM





FIGURE 8.3.1



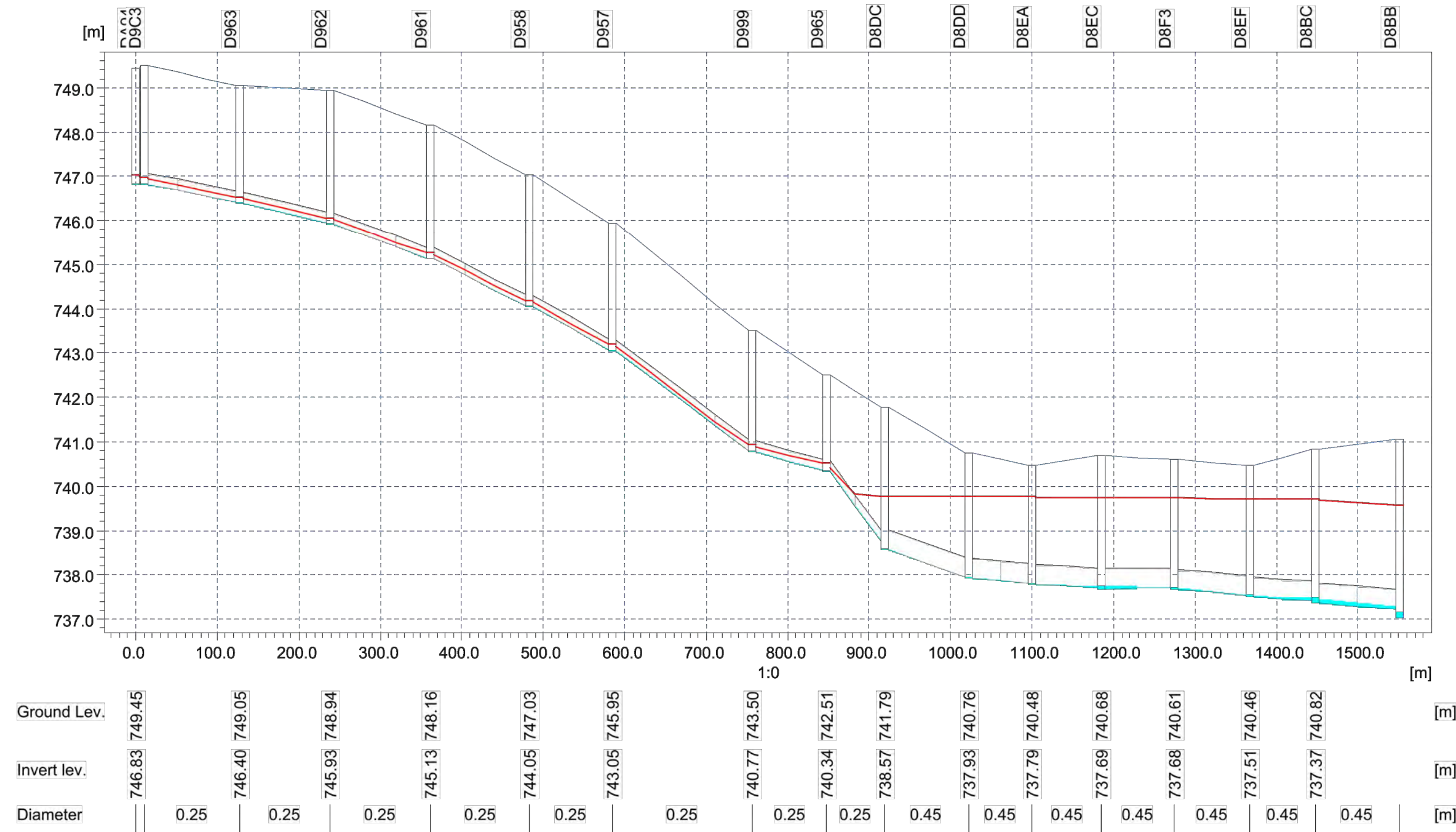
TOWN OF REDCLIFF  
SANITARY I-I STUDY  
FUTURE ASSESSMENT SCENARIO  
EXISTING TRUNK SEWER  
MAXIMUM HGL PROFILE - LP #1





FIGURE 8.3.2

Maximum HGL Profile – LP #2A – Future Ultimate WWF Scenario - 19-5-2014 00:00:00 HD-WWF ULT Sc1 FUT WWF - (50yr Huff Free Outfall).PRF

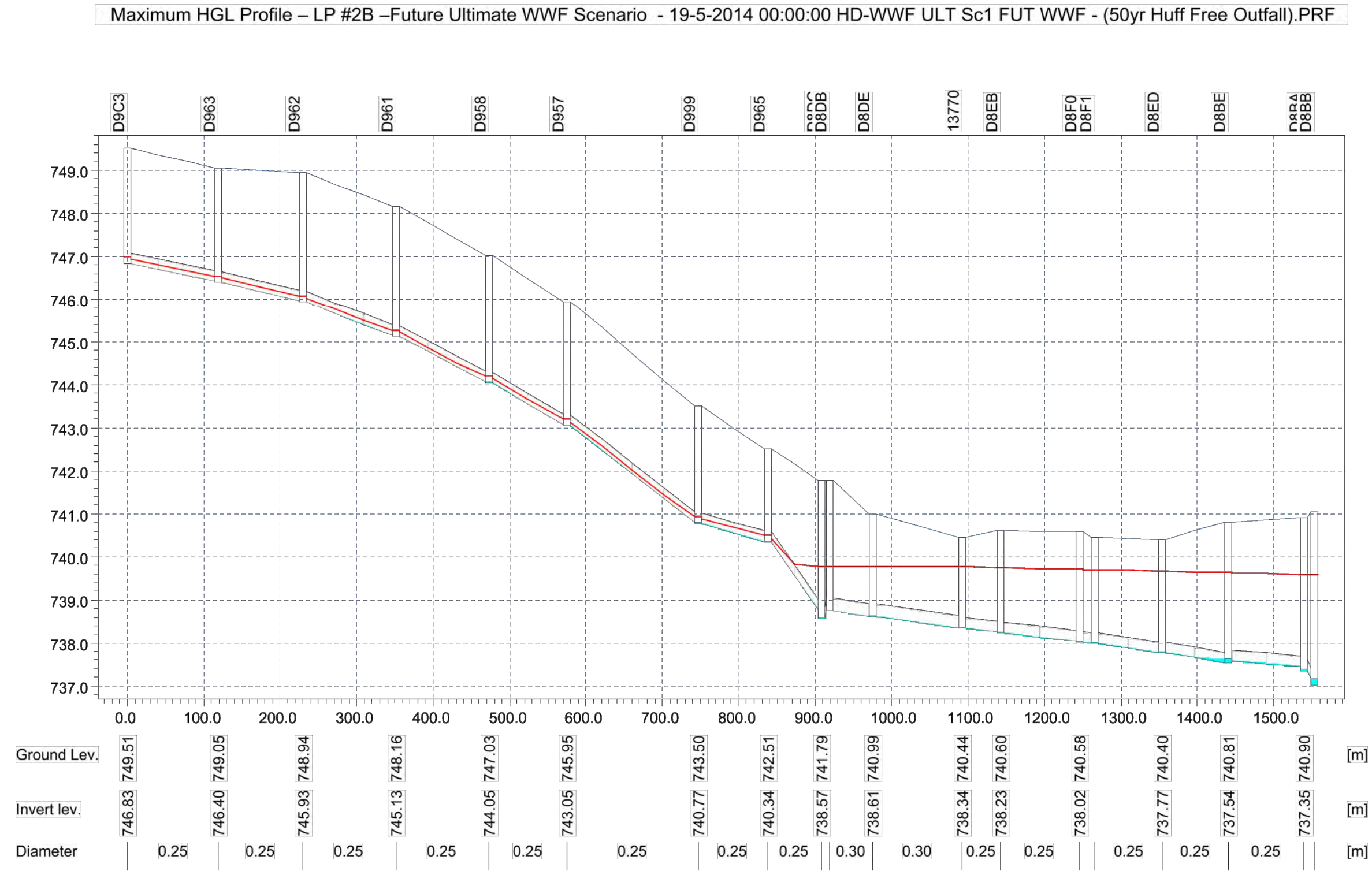


**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
FUTURE ASSESSMENT SCENARIO  
EXISTING TRUNK SEWER  
MAXIMUM HGL PROFILE - LP #2A



RAFAL\_JADZINSKI Apr. 7, 15 11:03:11 AM N:\26000\26031\_REDCLIFF\_SANITARY\_H\FIGURES\201\_DRAFTING\201\_FUT\_ASSESSMENTS - (NW LS & MC SEWER FIXED)\26031\_MAX HGL PROFILES - FUT ULT ASSESSMENT 50YR 24HR HUFF OF STORM (MC SEWER FIXED).DWG

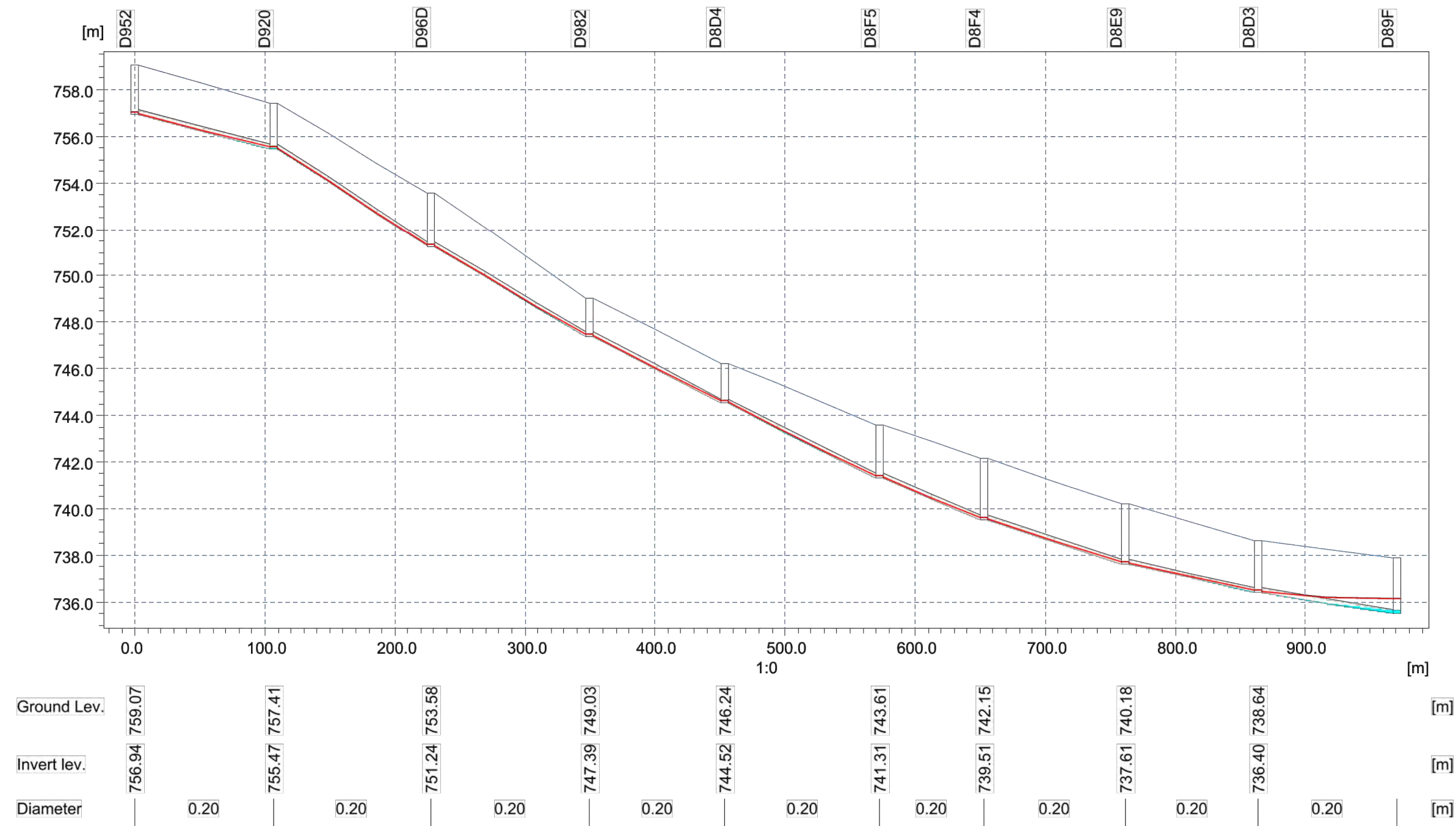
FIGURE 8.3.3



TOWN OF REDCLIFF  
SANITARY H STUDY  
FUTURE ASSESSMENT SCENARIO  
EXISTING TRUNK SEWER  
MAXIMUM HGL PROFILE - LP #2B

FIGURE 8.3.4

Maximum HGL Profile – LP #3 – Future Ultimate WWF Scenario - 19-5-2014 00:00:00 HD-WWF ULT Sc1 FUT WWF - (50yr Huff Free Outfall).PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
FUTURE ASSESSMENT SCENARIO  
EXISTING TRUNK SEWER  
MAXIMUM HGL PROFILE - LP #3

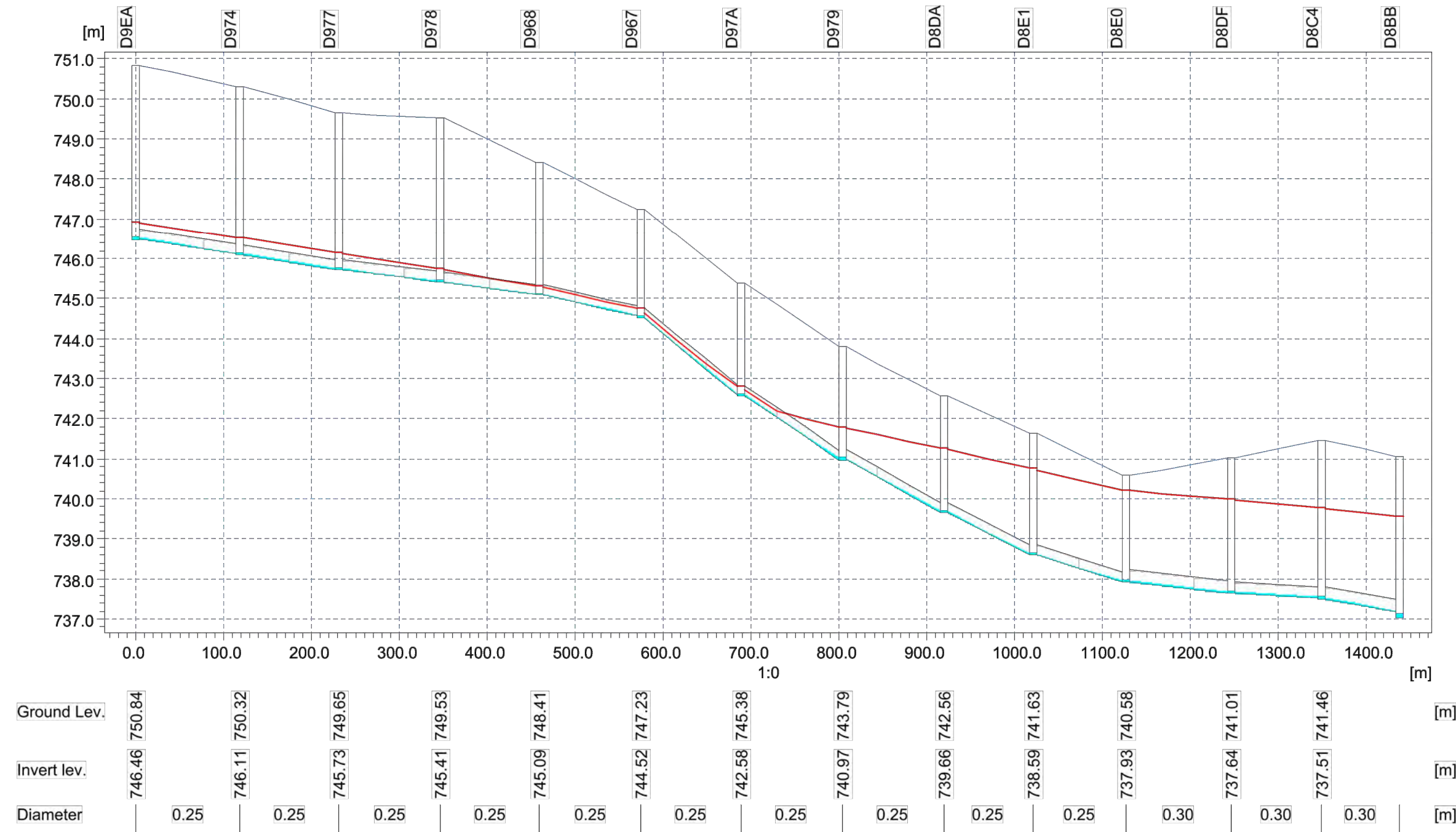


RAFAŁ JADZINSKI Apr. 7, 15 11:03:15 AM N:\26000\26031\_REDCLIFF\_SANITARY\_H\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\FUT ASSESSMENTS - (NW LS & MC SEWER FIXED)\26031\_MAX HGL PROFILES - FUT ULT ASSESSMENT 50YR 24HR HUFF OF STORM (MC SEWER FIXED).DWG



FIGURE 8.3.5

Maximum HGL Profile – LP #4 – Future Ultimate WWF Scenario - 19-5-2014 00:00:00 HD-WWF ULT Sc1 FUT WWF - (50yr Huff Free Outfall).PRF

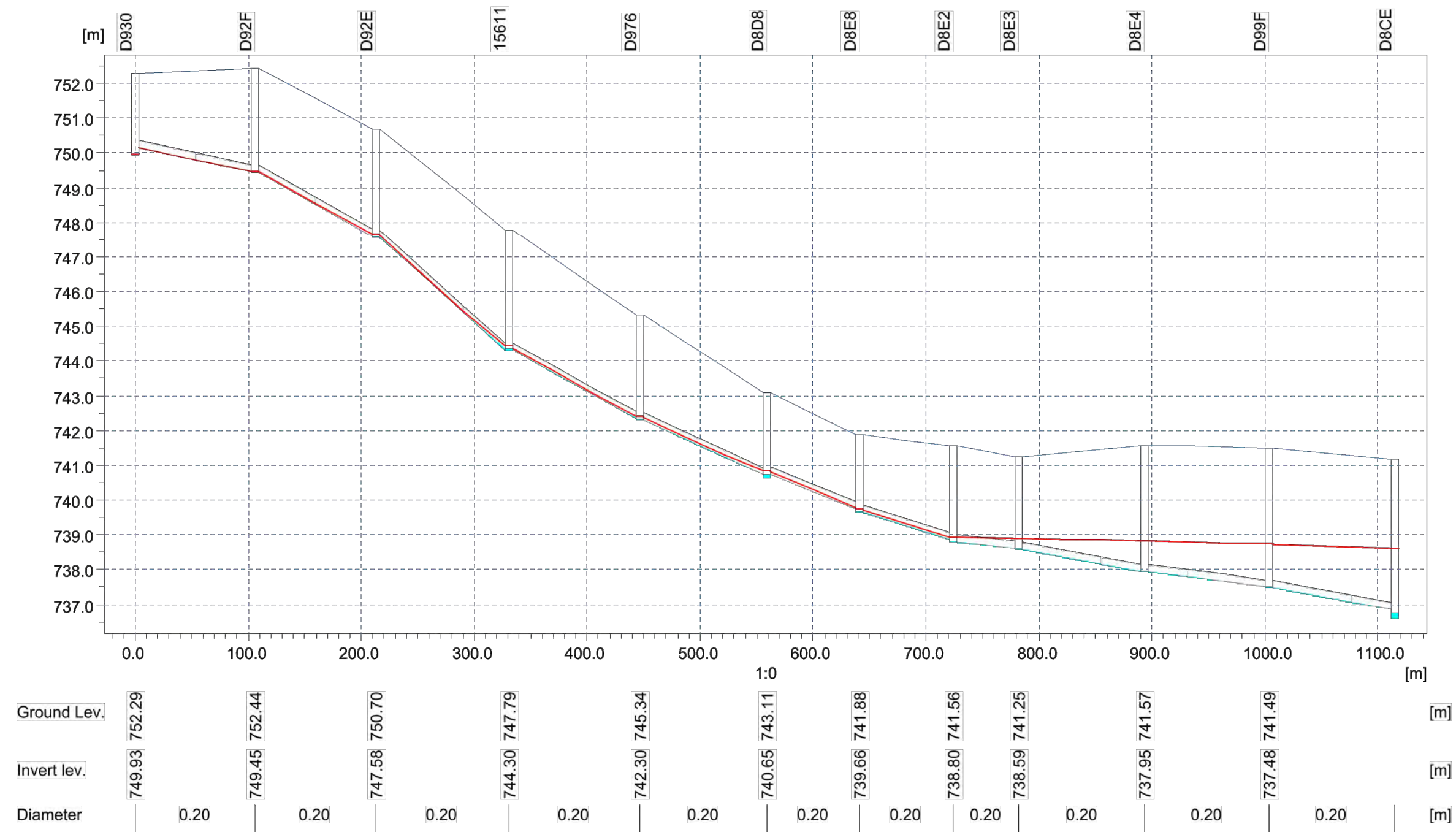


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE ASSESSMENT SCENARIO**  
**EXISTING TRUNK SEWER**  
**MAXIMUM HGL PROFILE - LP #4**



FIGURE 8.3.6

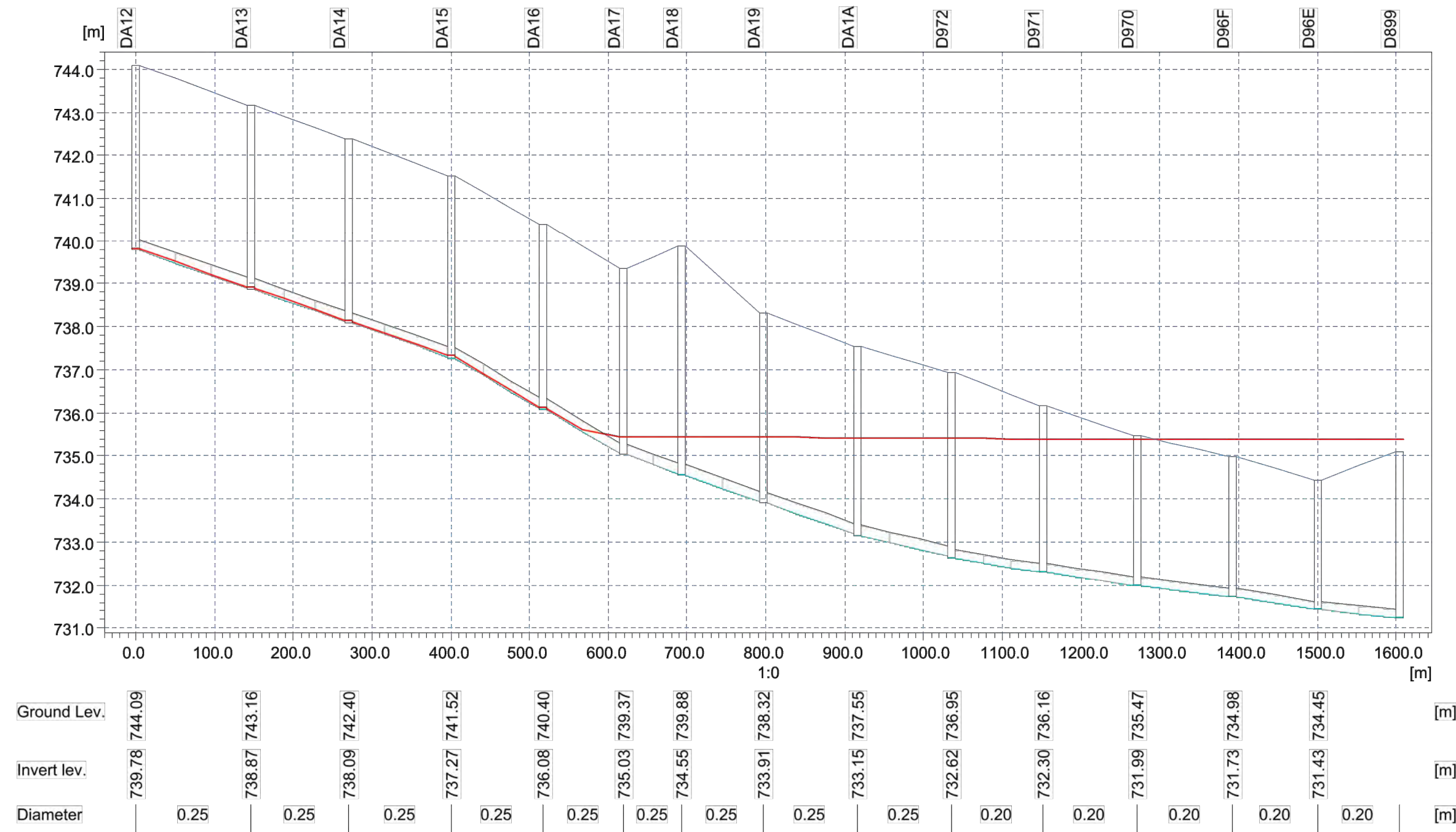
Maximum HGL Profile – LP #5 – Future Ultimate WWF Scenario - 19-5-2014 00:00:00 HD-WWF ULT Sc1 FUT WWF - (50yr Huff Free Outfall).PRF



TOWN OF REDCLIFF  
SANITARY I-I STUDY  
FUTURE ASSESSMENT SCENARIO  
EXISTING TRUNK SEWER  
MAXIMUM HGL PROFILE - LP #5

FIGURE 8.3.7

Maximum HGL Profile – LP #6 – Future Ultimate WWF Scenario - 19-5-2014 00:00:00 HD-WWF ULT Sc1 FUT WWF - (50yr Huff Free Outfall).PRF



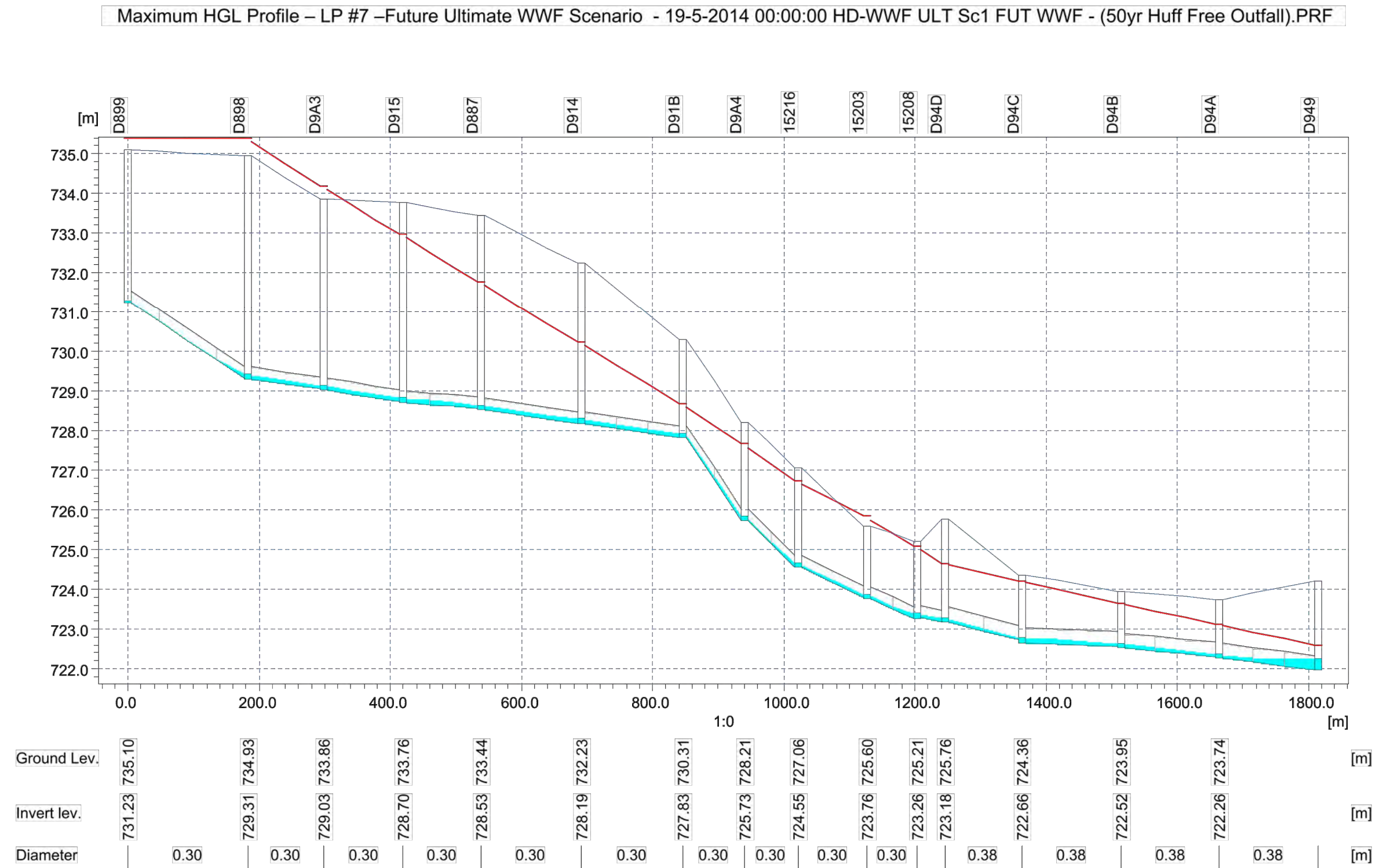
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE ASSESSMENT SCENARIO**  
**EXISTING TRUNK SEWER**  
**MAXIMUM HGL PROFILE - LP #6**



RAFAŁ JADZINSKI Apr. 7, 15 11:03:18 AM N:\26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\FUT\_ASSESSMENTS - (NW LS & MC SEWER FIXED)\26031\_MAX HGL PROFILES - FUT ULT ASSESSMENT 50YR 24HR HUFF OF STORM (MC SEWER FIXED).DWG



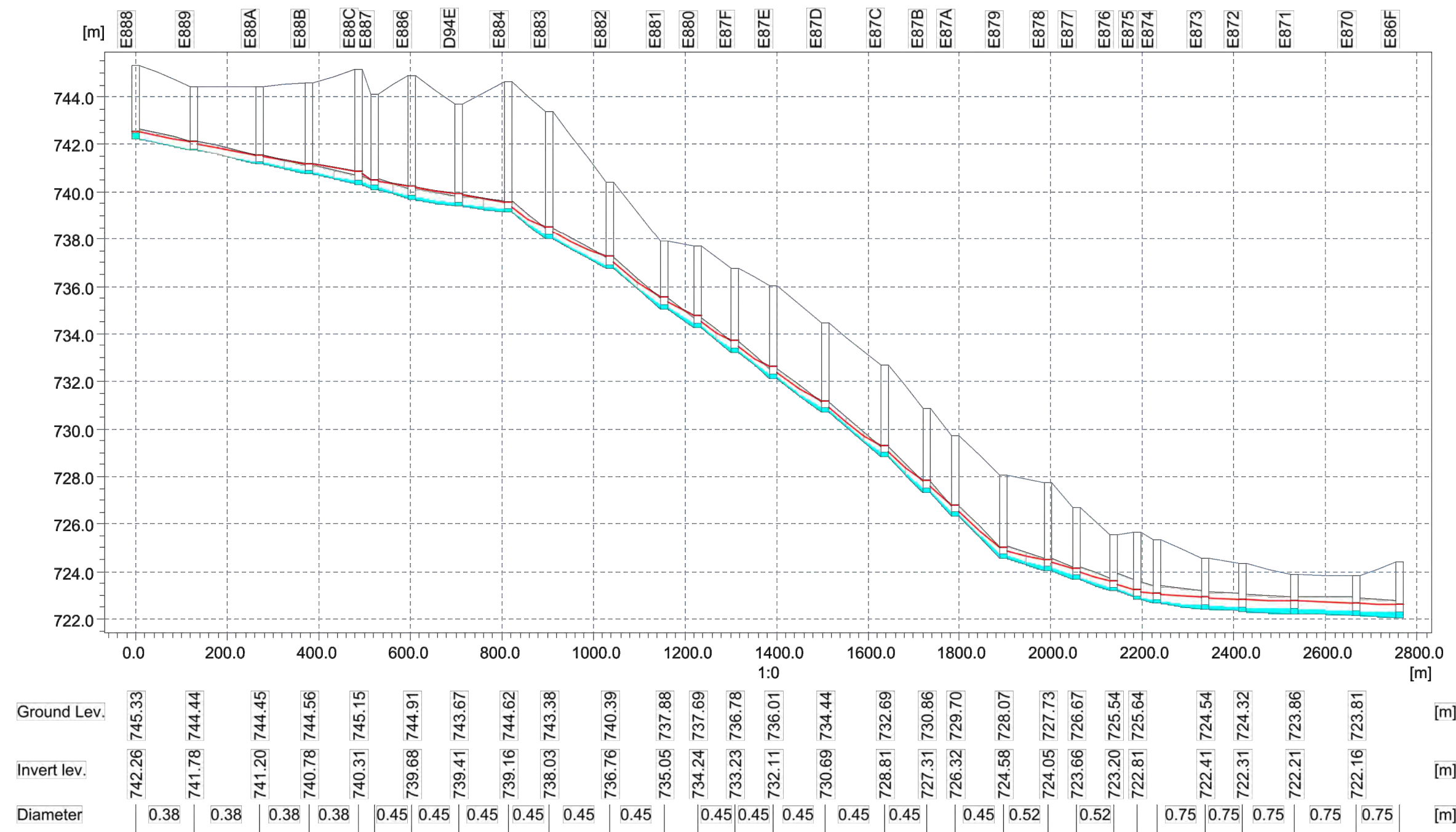
FIGURE 8.3.8



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE ASSESSMENT SCENARIO**  
**EXISTING TRUNK SEWER**  
**MAXIMUM HGL PROFILE - LP #7**

FIGURE 8.3.9

Maximum HGL Profile - LP #8 - Future Ultimate WWF Scenario - 19-5-2014 00:00:00 HD-WWF ULT Sc1 FUT WWF - (50yr Huff Free Outfall).PRF

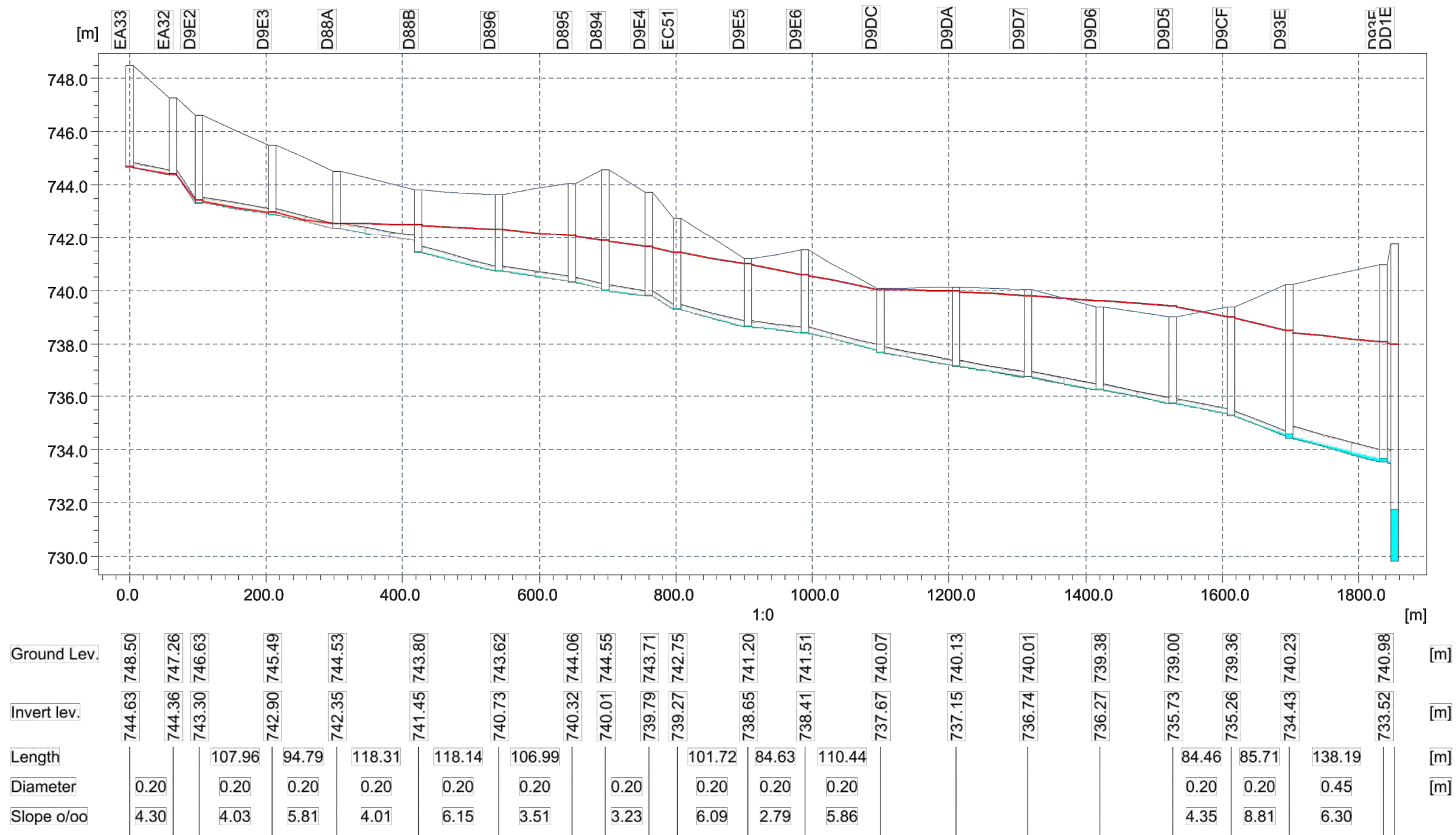


**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE ASSESSMENT SCENARIO**  
**EXISTING TRUNK SEWER**  
**MAXIMUM HGL PROFILE - LP #9**

RAFAL\_JADZINSKI Apr 7, 15 11:03:20 AM N: 26000\26031\_REDCLIFF\_SANITARY\_02\_CADD\20\_DRAFTING\201\_FIGURES\PS\FUT\_ASSESSMENTS - (NW LS & MC SEWER FIXED)\26031\_MAX HGL PROFILES - FUT ULT ASSESSMENT 50YR 24HR HUFF OF STORM (MC SEWER FIXED).DWG

FIGURE 8.3.10

Maximum HGL Profile – LP #9 – Future Ultimate WWF Scenario - 19-5-2014 00:00:00 HD-WWF ULT Sc1 FUT WWF - (50yr Huff Free Outfall).PRF

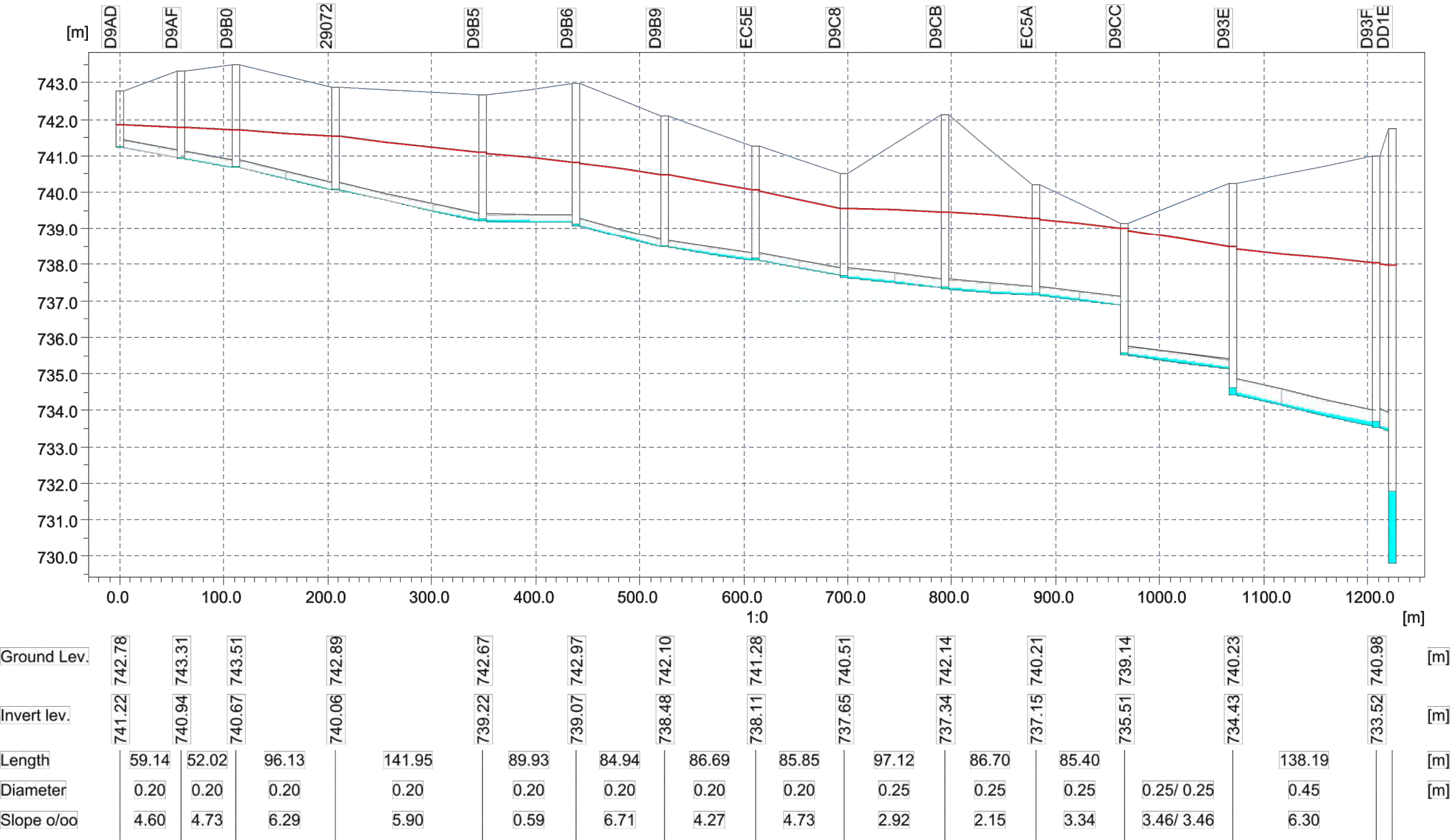


TOWN OF REDCLIFF  
SANITARY H STUDY  
FUTURE ASSESSMENT SCENARIO  
EXISTING TRUNK SEWER  
MAXIMUM HGL PROFILE - LP #9



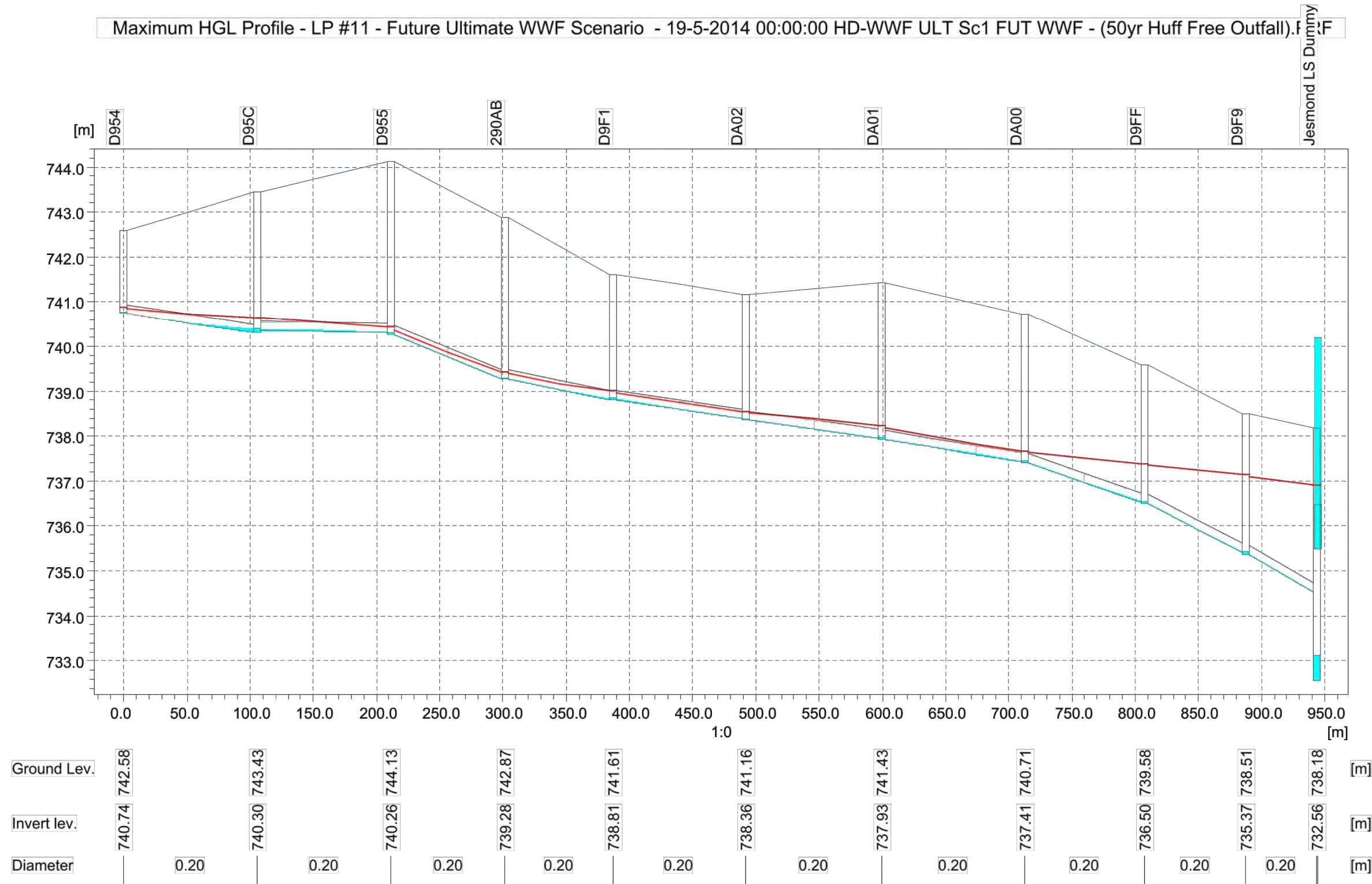
FIGURE 8.3.11

Maximum HGL Profile – LP #10 – Future Ultimate WWF Scenario - 19-5-2014 00:00:00 HD-WWF ULT Sc1 FUT WWF - (50yr Huff Free Outfall).PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE ASSESSMENT SCENARIO**  
**EXISTING TRUNK SEWER**  
**MAXIMUM HGL PROFILE - LP #10**

FIGURE 8.3.12



**TOWN OF REDCLIFF**  
**SANITARY STUDY**  
**FUTURE ASSESSMENT SCENARIO**  
**EXISTING TRUNK SEWER**  
**MAXIMUM HGL PROFILE - LP #11**



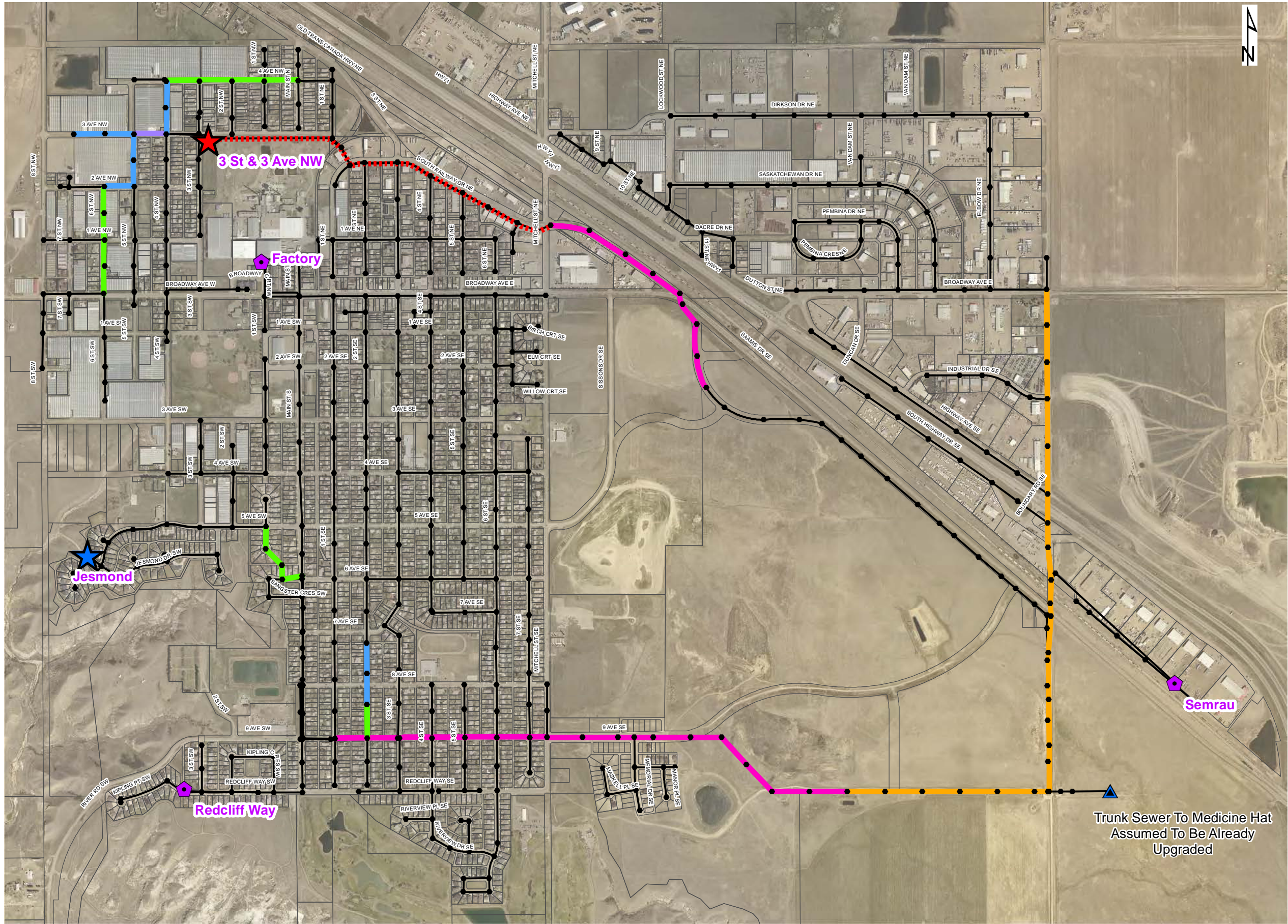


FIGURE 8.4

## Legend

### Sanitary Gravity Trunk

- Proposed Twin 200mm
- Proposed Twin 250mm
- Proposed Twin 300mm
- Proposed Twin 375mm
- Proposed Twin 450mm

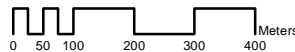
### Sanitary Forcemain

- Proposed Twin 375mm

### Proposed Lift Station

- New Capacity of 248L/s
- New Active Storage of 60.5 cu.m & New Capacity of 33.1L/s
- Existing Lift Station
- Existing Sanitary Trunk

1:12,500



## TOWN OF REDCLIFF SANITARY I-I STUDY

CONCEPTUAL UPGRADES  
(WITH SEWER TO MEDICINE HAT UPSIZED)  
FUTURE (UTIMATE) SYSTEM  
SCENARIO 1





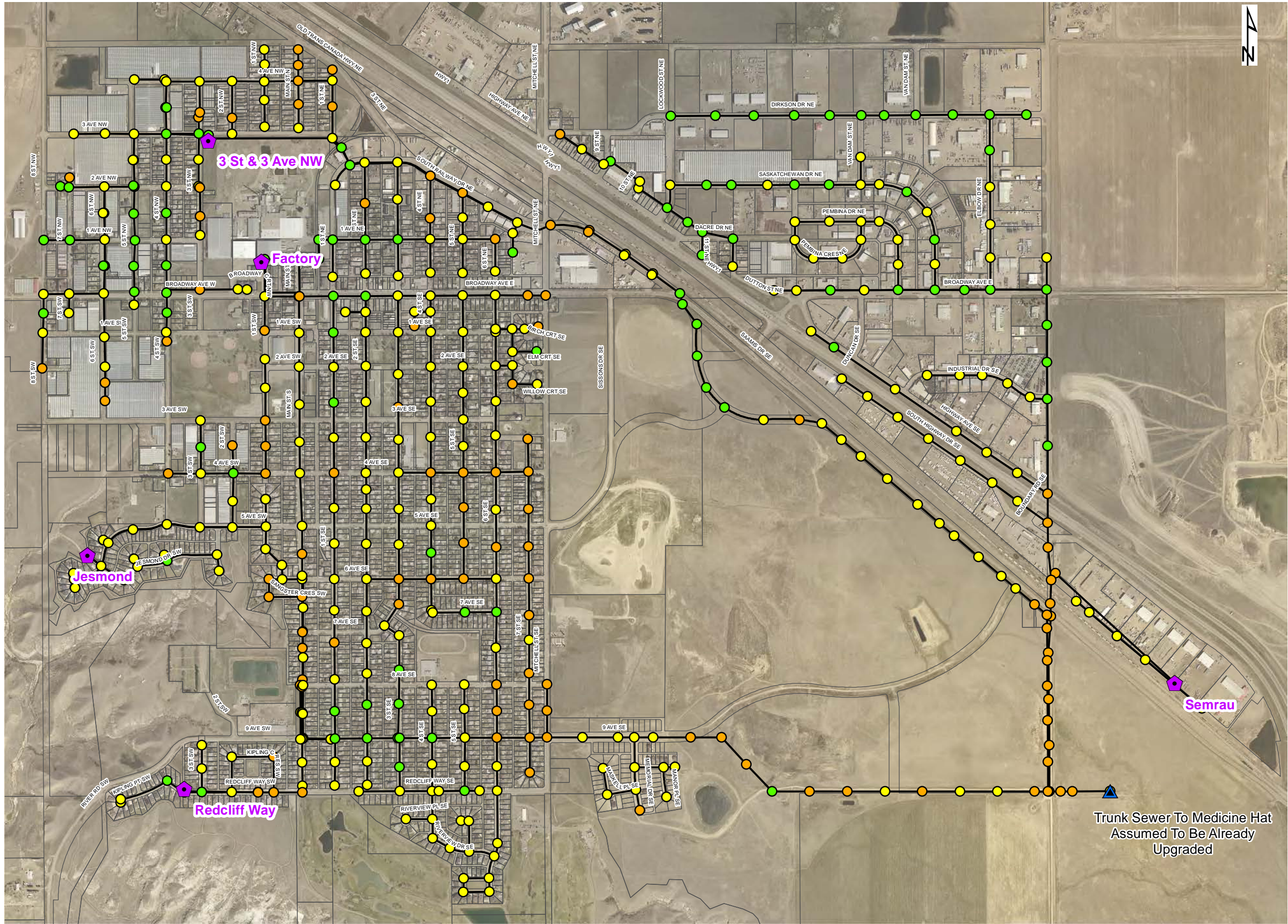
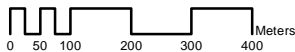


FIGURE 8.5

## Legend

- Less Than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and -0.50m
- Greater Than 0.00m
- Lift Station
- Sanitary Trunk

1:12,500



### TOWN OF REDCLIFF SANITARY I-I STUDY

PEAK HGL RELATIVE TO GROUND  
(WITH SEWER TO MEDICINE HAT UPSIZED)  
FUTURE (ULTIMATE) SYSTEM  
SCENARIO 1



Trunk Sewer To Medicine Hat  
Assumed To Be Already  
Upgraded



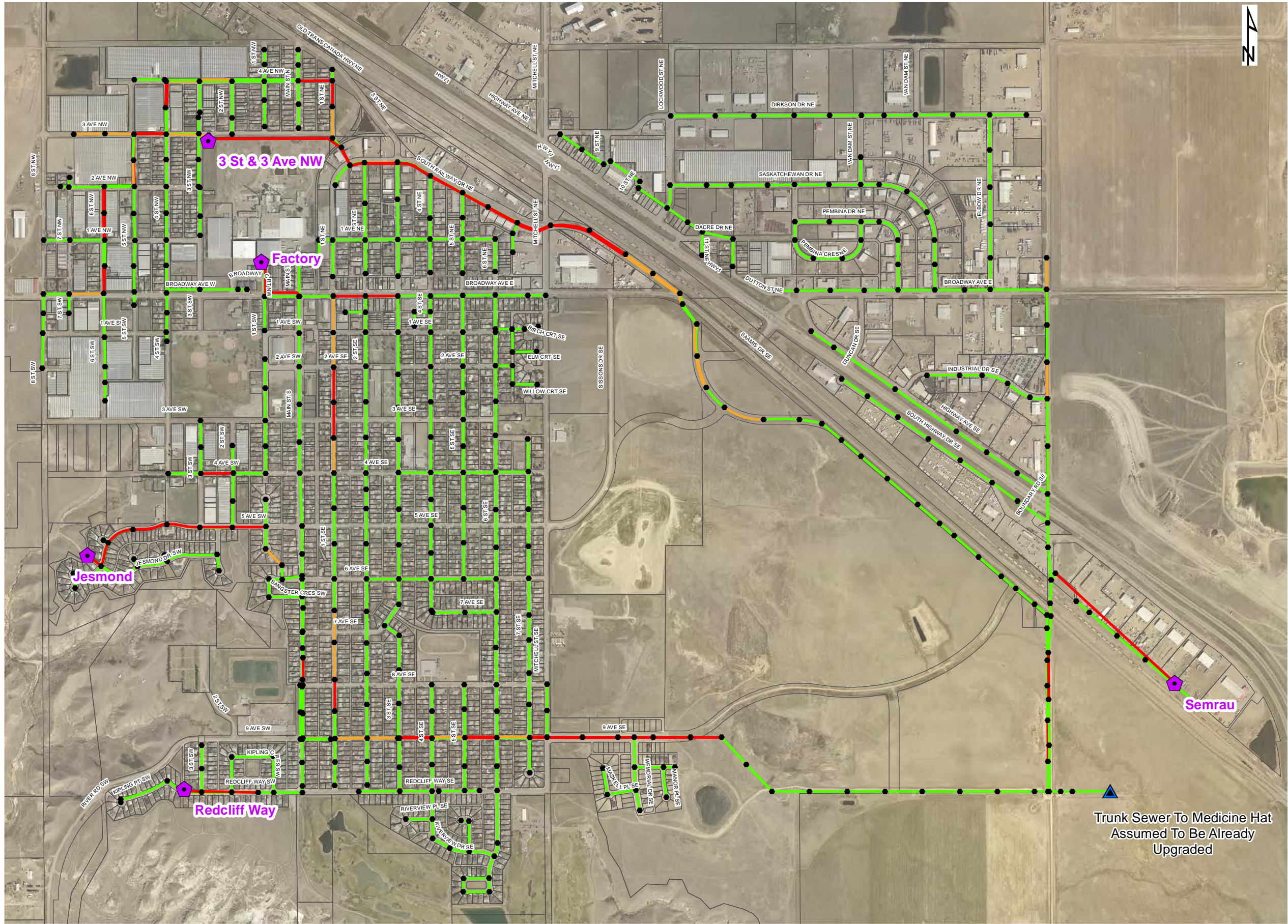
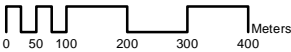


FIGURE 8.6

Legend

- Greater Than 100%
- Between 86% and 100%
- Less Than 86%
- Lift Station

1:12,500



TOWN OF REDCLIFF  
SANITARY I-I STUDY

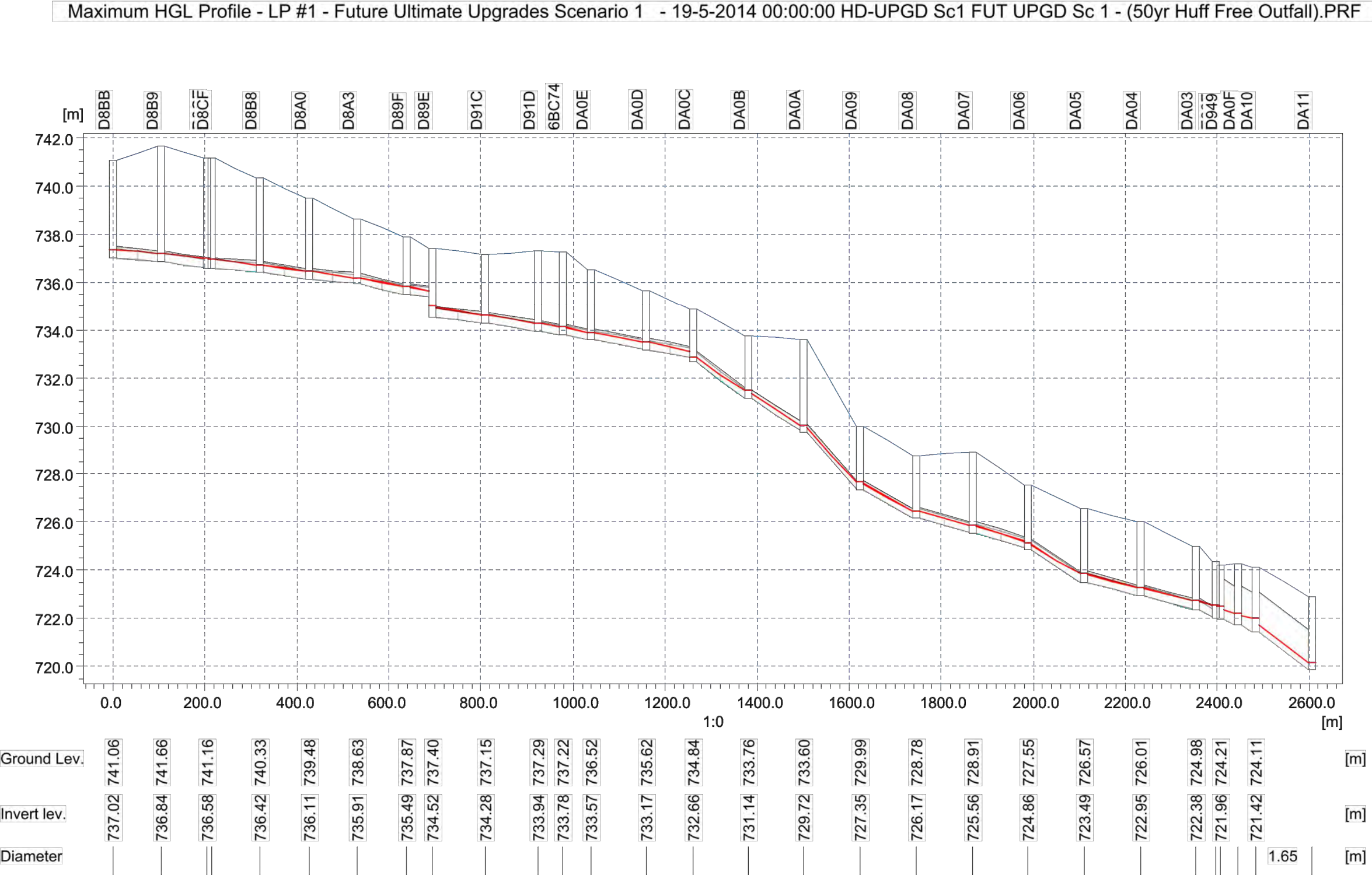
PEAK DISCHARGE RELATIVE TO PIPE CAPACITY  
(WITH SEWER TO MEDICINE HAT UPSIZED)  
FUTURE (ULTIMATE) SYSTEM  
SCENARIO 1





FIGURE 8.7.1

RAFAŁ JADZINSKI, Apr. 7, 15, 11:04:40 AM, N: 26000\26031\_REDCLIFF\_SANITARY\_1\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\FUT\_UPGRADES - SCENARIO 1\26031\_MAX\_HGL\_PROFILES - FUT ULT UPGRADE\50YR\_24HR\_HUFF\_04\_STORM (MC SEWER FREE) SCENARIO 1.DWG

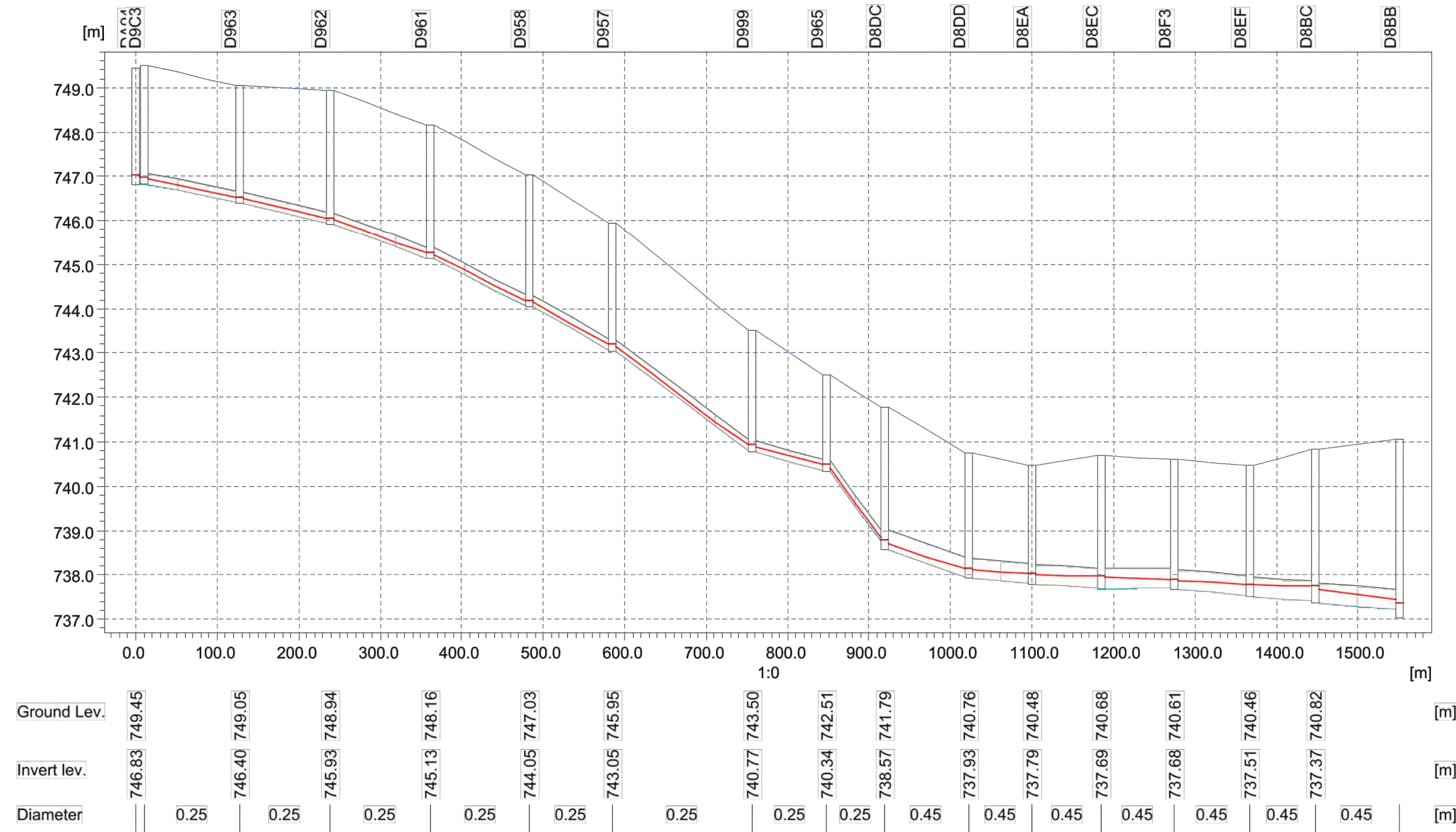


TOWN OF REDCLIFF  
SANITARY I-I STUDY  
FUTURE UPGRADES - SCENARIO 1  
MEDICINE HAT SEWER UPGRADED  
MAXIMUM HGL PROFILE - LP#1



FIGURE 8.7.2

Maximum HGL Profile – LP #2A – Future Ultimate Upgrades Scenario 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF



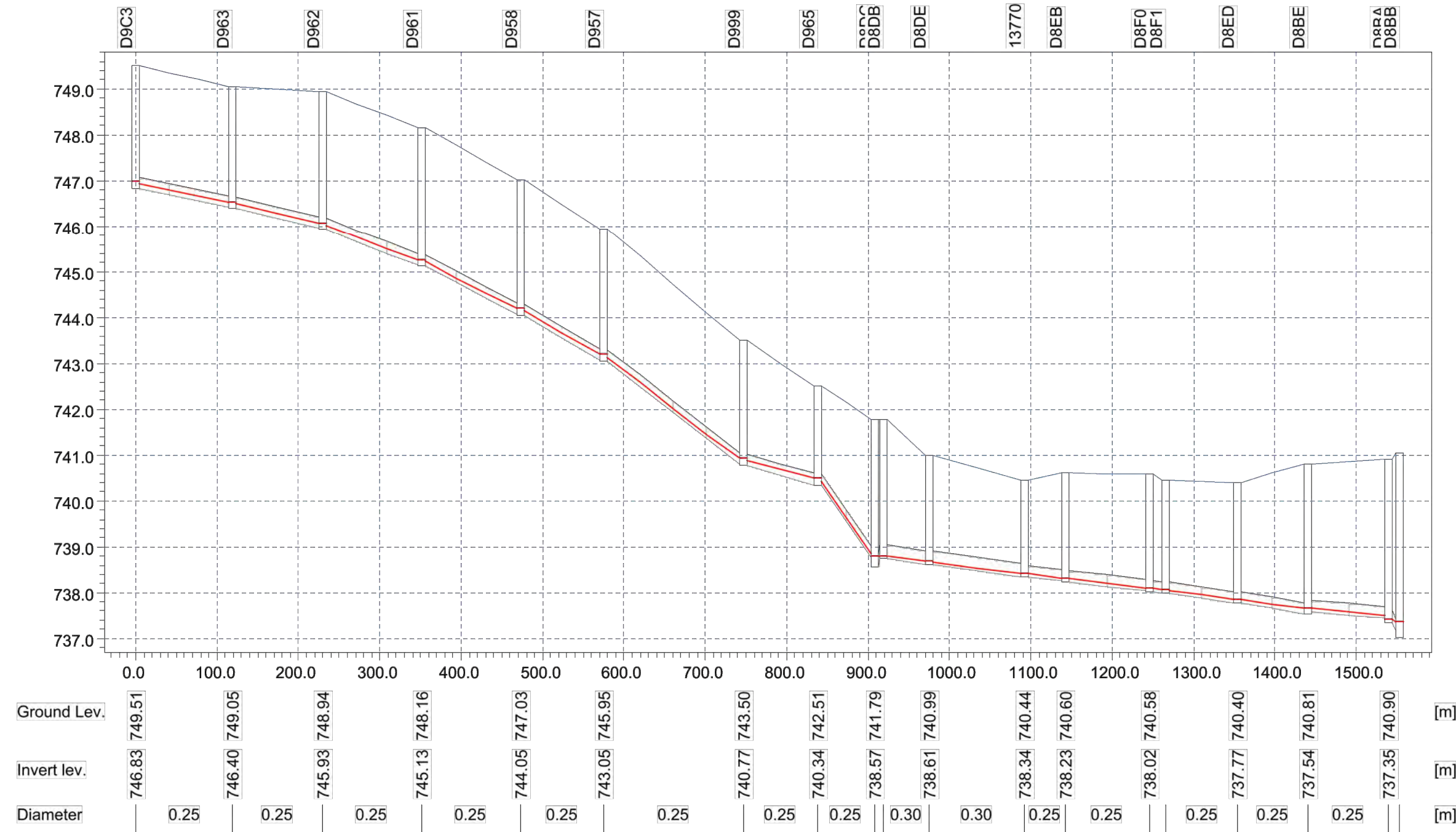
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#2A**



RAFAŁ JADZINSKI Apr. 7, 15 11:04:41 AM N: 26000\26031\_REDCLIFF\_SANITARY\_I-I\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\FUT UPGRADES - SCENARIO 1\26031\_MAX HGL PROFILES - FUT ULT UPGRADES 50YR 24HR HUFF 04 STORM (MC SEWER FREE) SCENARIO 1.DWG

FIGURE 8.7.3

Maximum HGL Profile – LP #2B – Future Ultimate Upgrades Scenario 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF



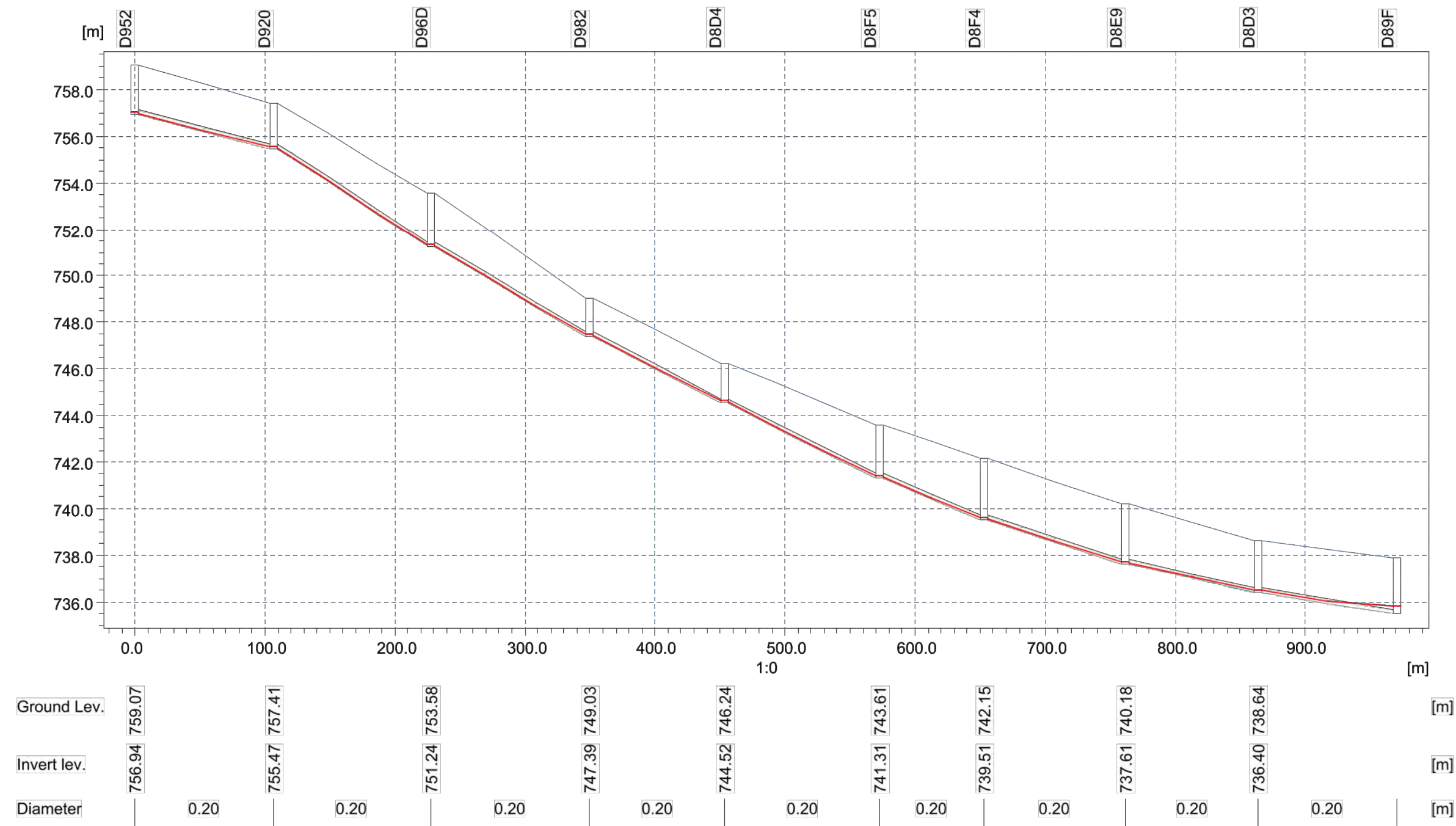
**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#2B**



RAFAŁ JADZINSKI Apr. 7, 15 11:04:43 AM N: 26000\26031\_REDCLIFF\_SANITARY\_H\_H\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\FUT UPGRADES - SCENARIO 1\26031\_MAX HGL PROFILES - FUT ULT UPGRADES 50YR 24HR HUFF 04 STORM (MC SEWER FREE) SCENARIO 1.DWG

FIGURE 8.7.4

Maximum HGL Profile – LP #3 –Future Ultimate Upgrades Scenario 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF



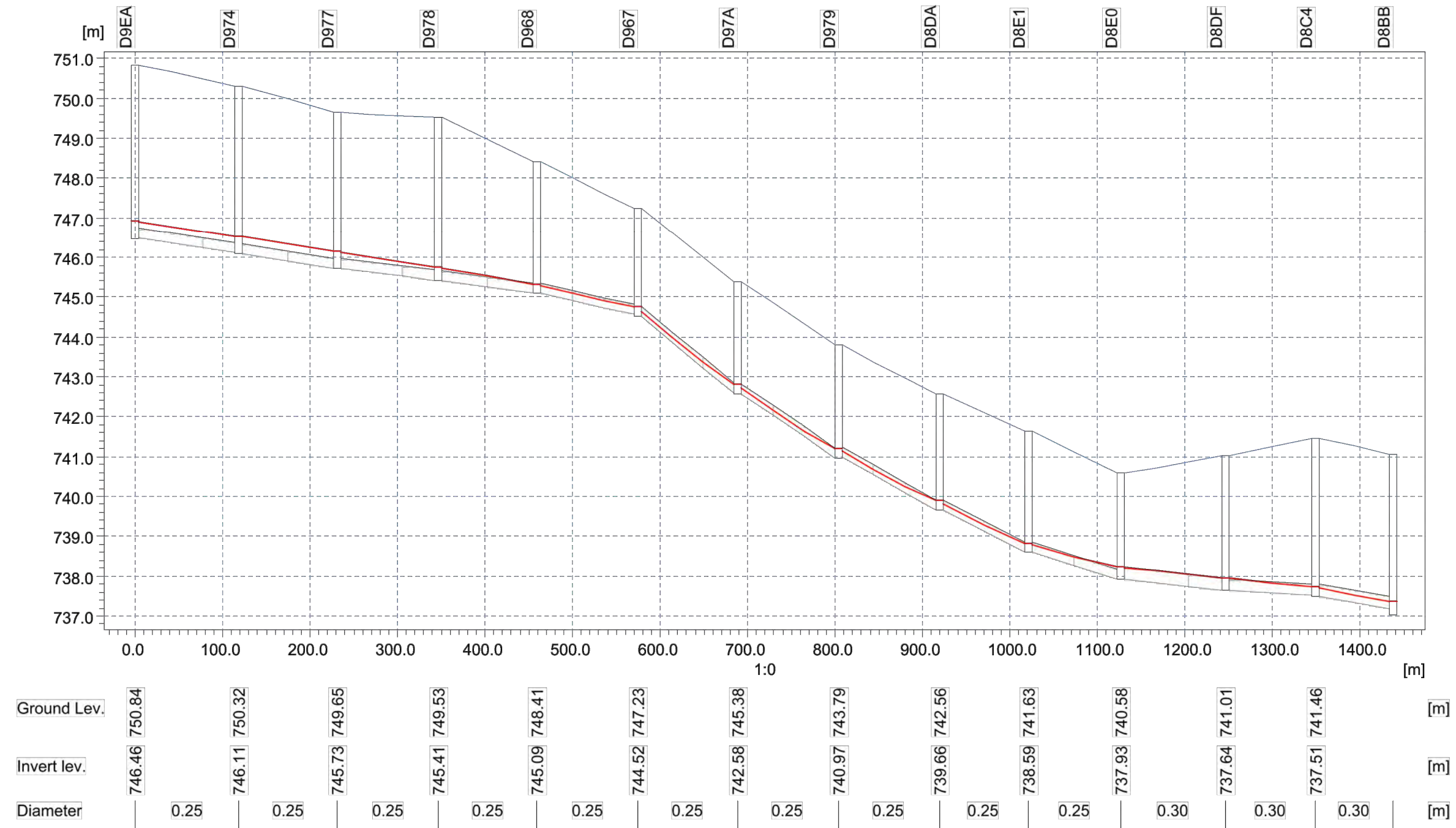
**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#3**





FIGURE 8.7.5

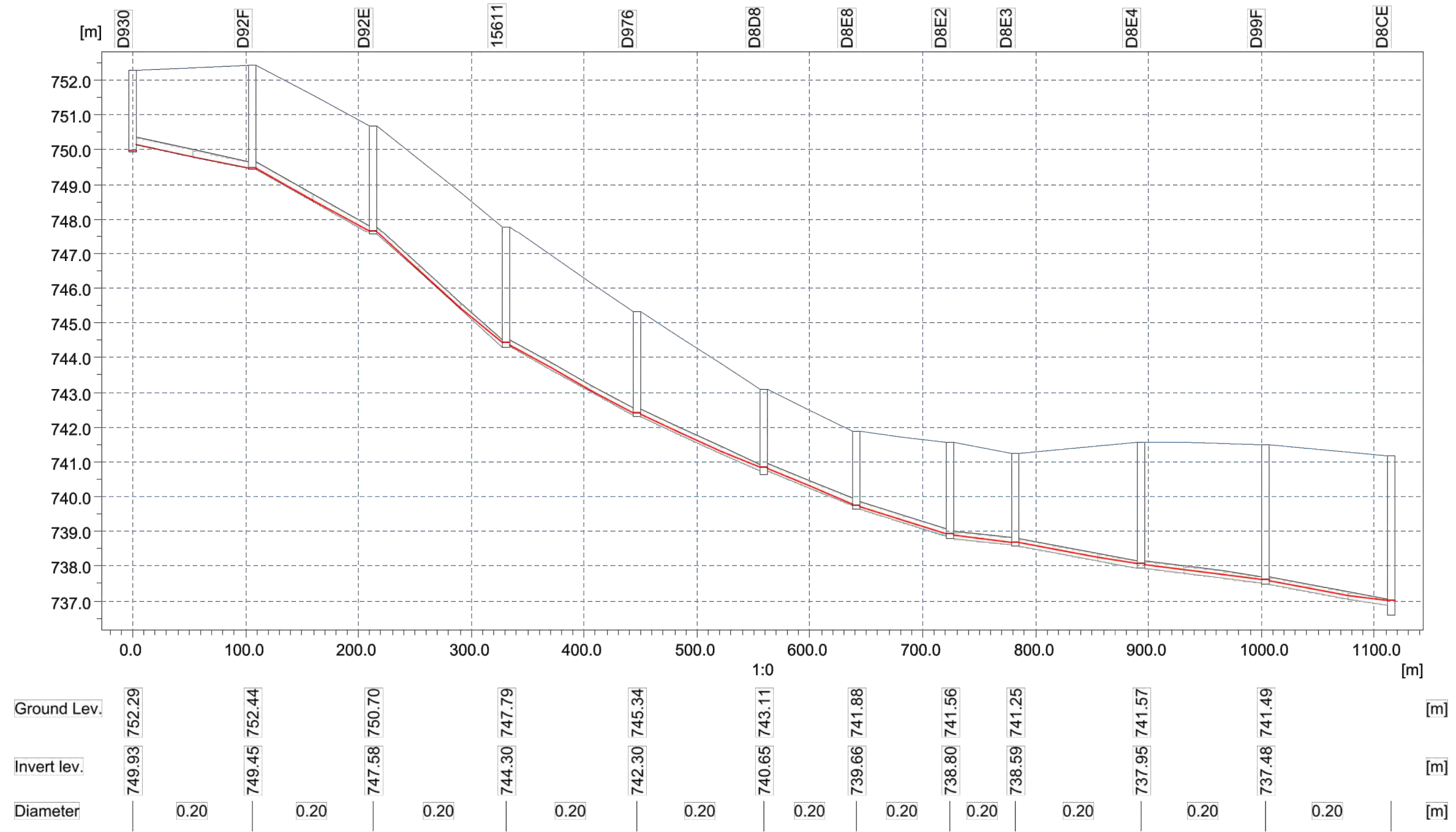
Maximum HGL Profile – LP #4 –Future Ultimate Upgrades Scenario 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#4**

FIGURE 8.7.6

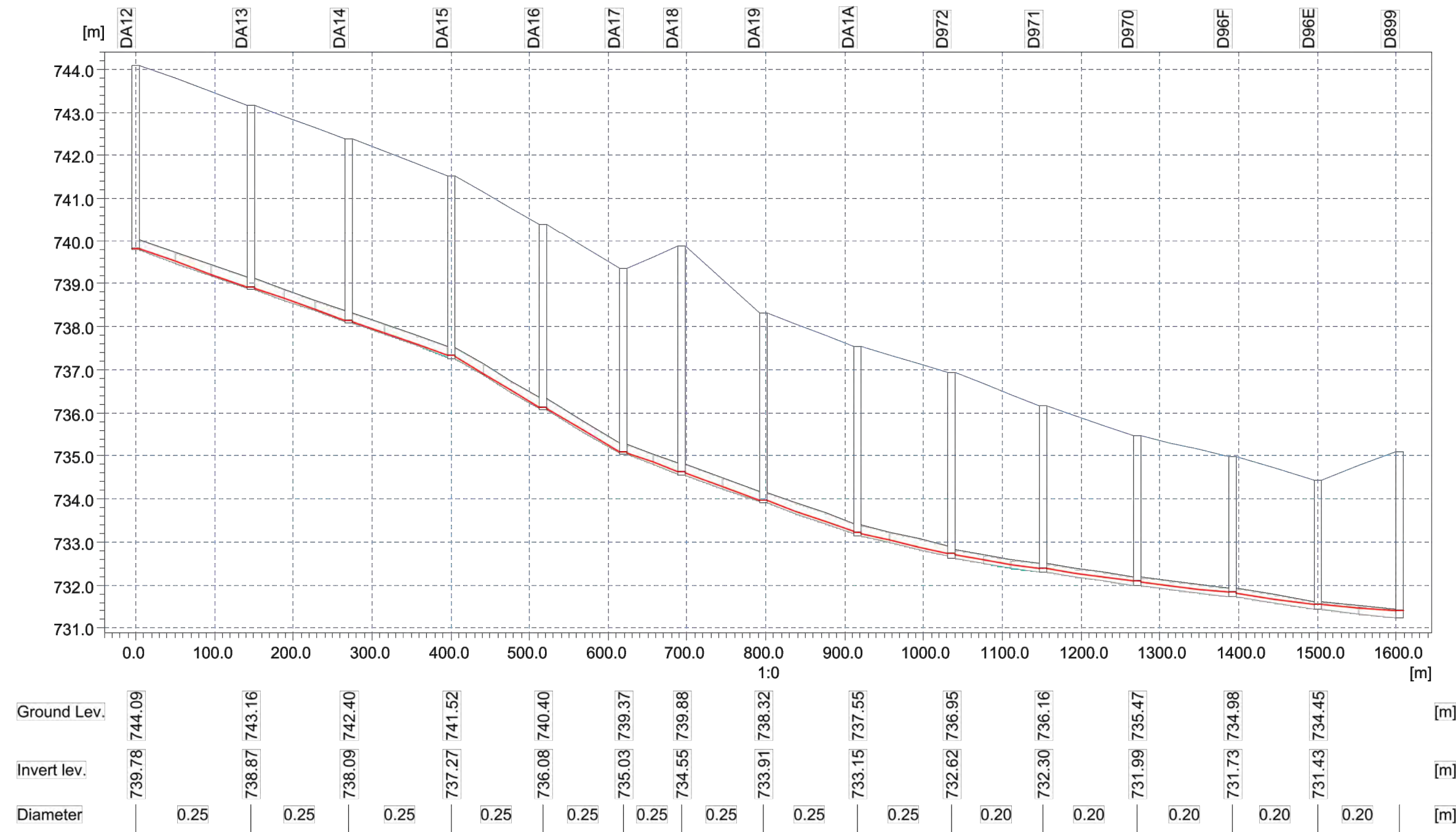
Maximum HGL Profile – LP #5 –Future Ultimate Upgrades Scenario 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#5**

FIGURE 8.7.7

Maximum HGL Profile – LP #6 – Future Ultimate Upgrades Scenario 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF



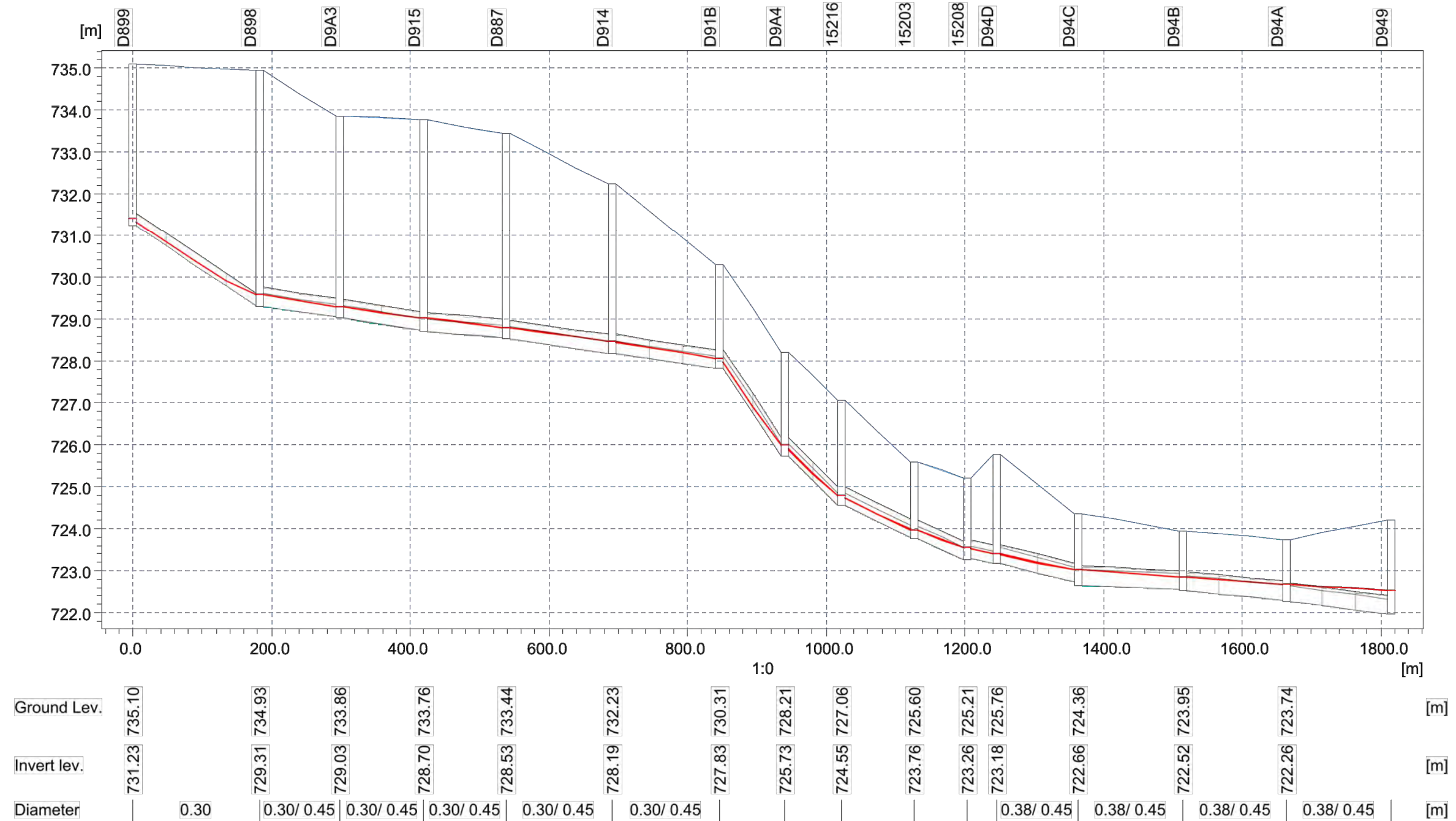
**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#6**

RAFAŁ JADZINSKI Apr. 7, 15 11:04:47 AM N: 26000\26031\_REDCLIFF\_SANITARY\_H\_H\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\FUT UPGRADES - SCENARIO 1\26031\_MAX HGL PROFILES - FUT ULT UPGRADEST 50YR 24HR HUFF 04 STORM (MC SEWER FREE) SCENARIO 1.DWG



FIGURE 8.7.8

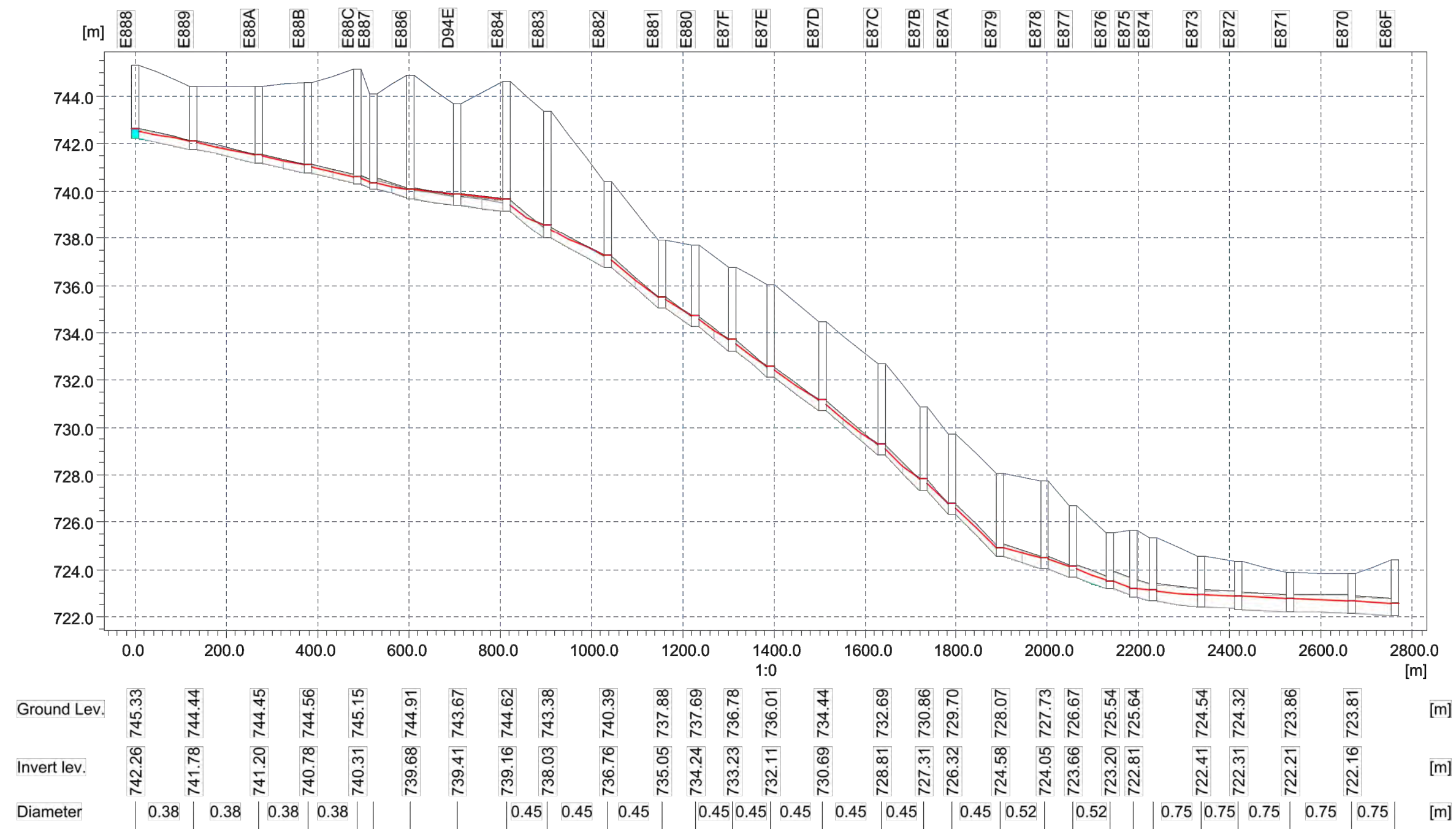
Maximum HGL Profile – LP #7 –Future Ultimate Upgrades Scenario 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#7**

FIGURE 8.7.9

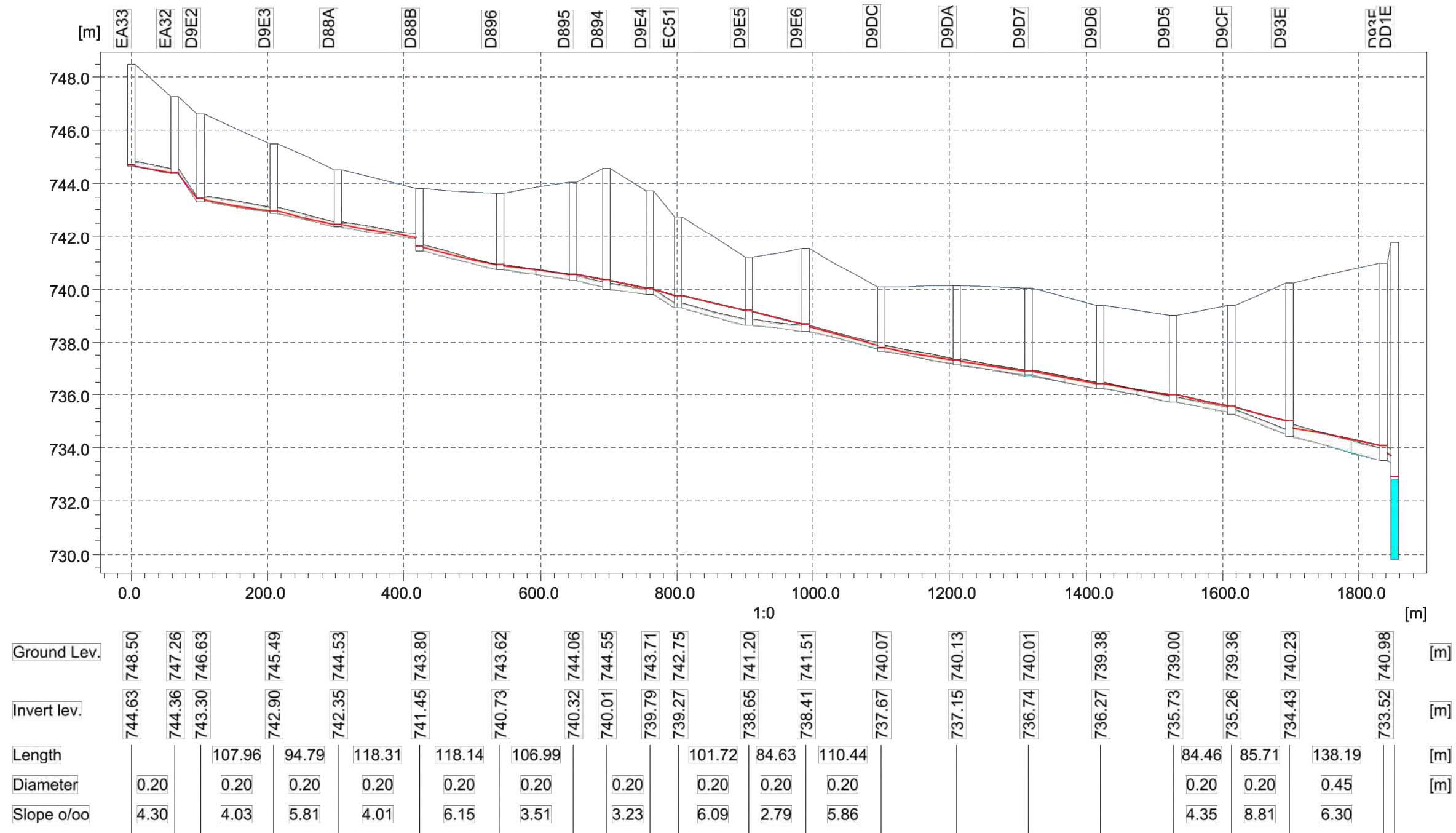
Maximum HGL Profile - LP #8 -Future Ultimate Upgrades Scenario 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#8**

FIGURE 8.7.10

Maximum HGL Profile – LP #9 – Future Ultimate Upgrades Scenario 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF

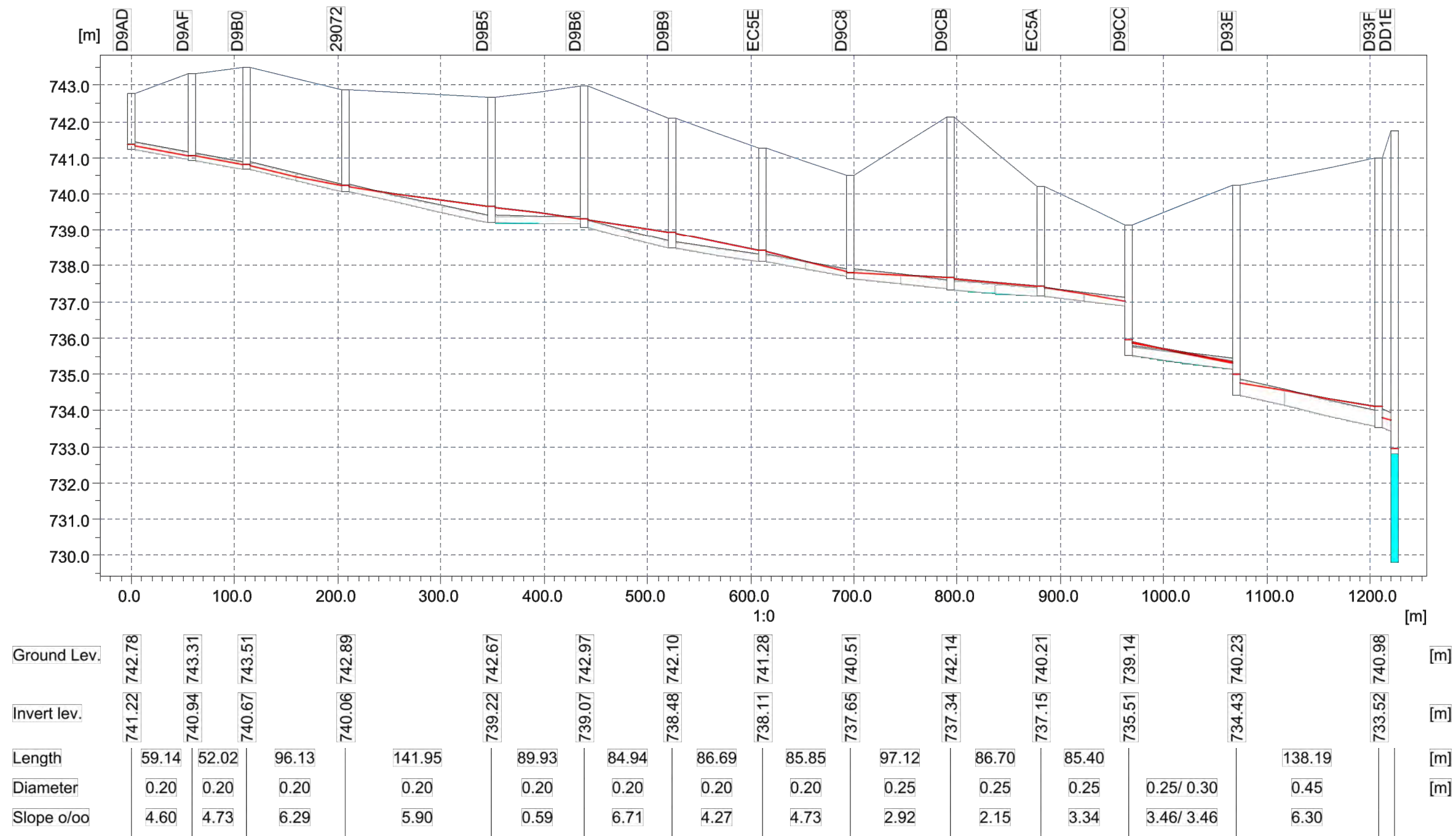


**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#9**



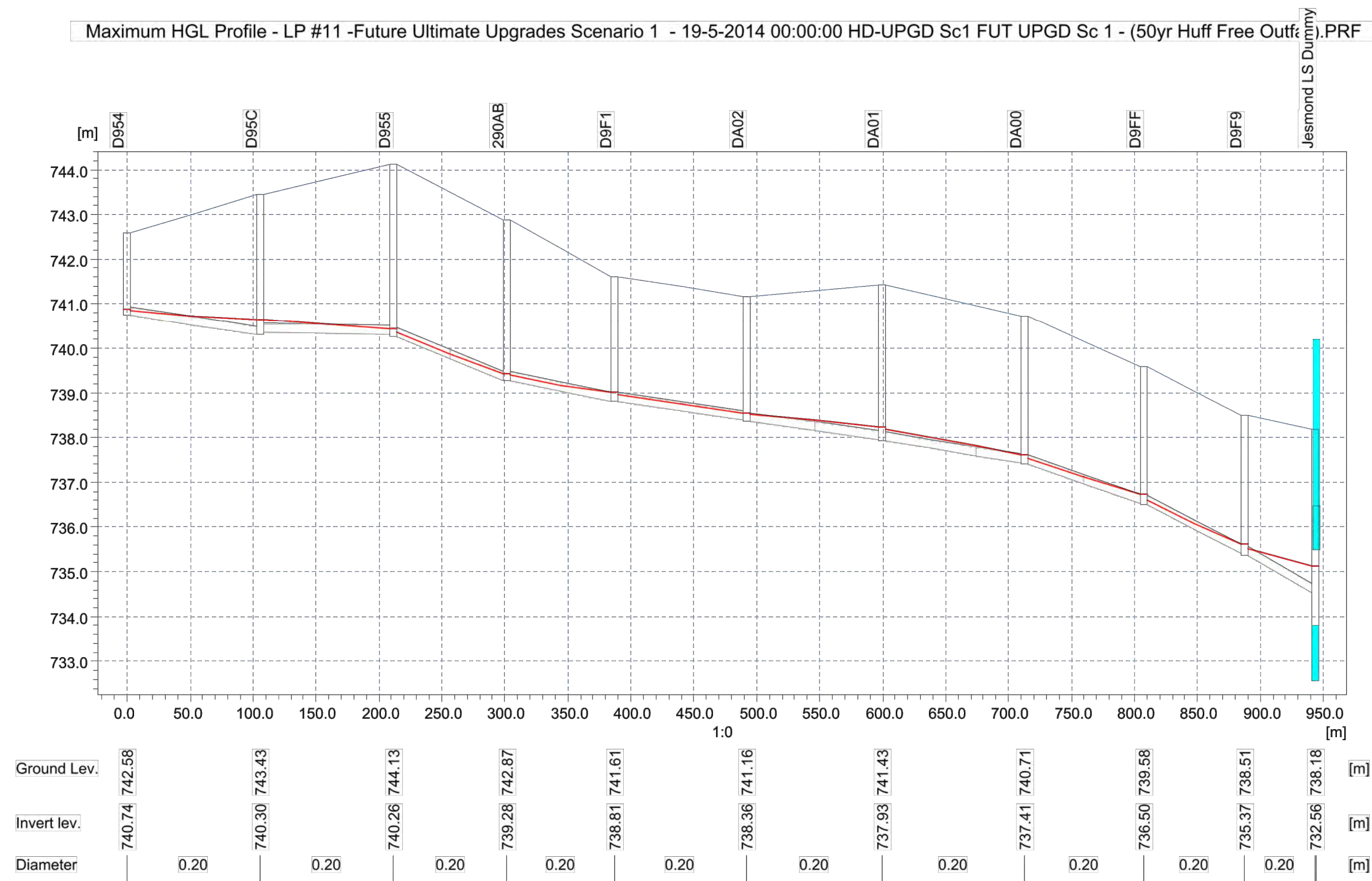
FIGURE 8.7.11

Maximum HGL Profile – LP #10 – Future Ultimate Upgrades Scenario 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#10**

FIGURE 8.7.12



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 1**  
**MEDICINE HAT SEWER UPGRADED**  
**MAXIMUM HGL PROFILE - LP#11**

RAFAŁ JADZINSKI Apr. 7, 15 11:04:52 AM N: 26000\26031\_REDCLIFF\_SANITARY - SCENARIO 1 - 19-5-2014 00:00:00 HD-UPGD Sc1 FUT UPGD Sc 1 - (50yr Huff Free Outfall).PRF



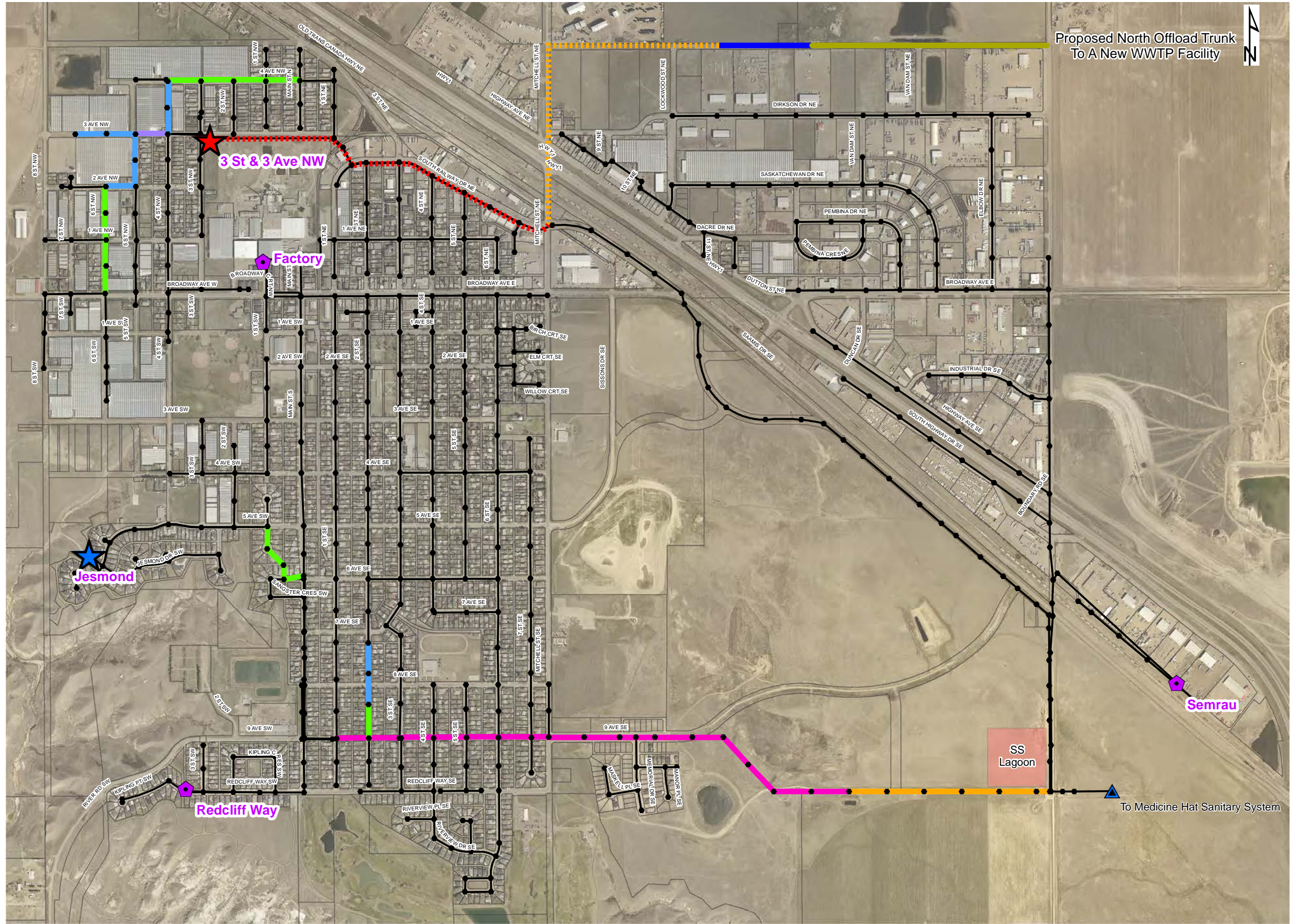


FIGURE 8.8

## Legend

### Sanitary Gravity Trunk

- Proposed Twin 200mm
- Proposed Twin 250mm
- Proposed Twin 300mm
- Proposed Twin 375mm
- Proposed Twin 450mm
- Proposed 525mm
- Proposed 750mm

### Sanitary Forcemain

- Proposed Twin 375mm
- Proposed 450mm

### Proposed Lift Station

- New Capacity of 248L/s
- New Active Storage of 60.5 cu.m & New Capacity of 33.1L/s
- Surcharge Suppression Lagoon. Maximum Footprint of 36,170 sq.m

1:12,500

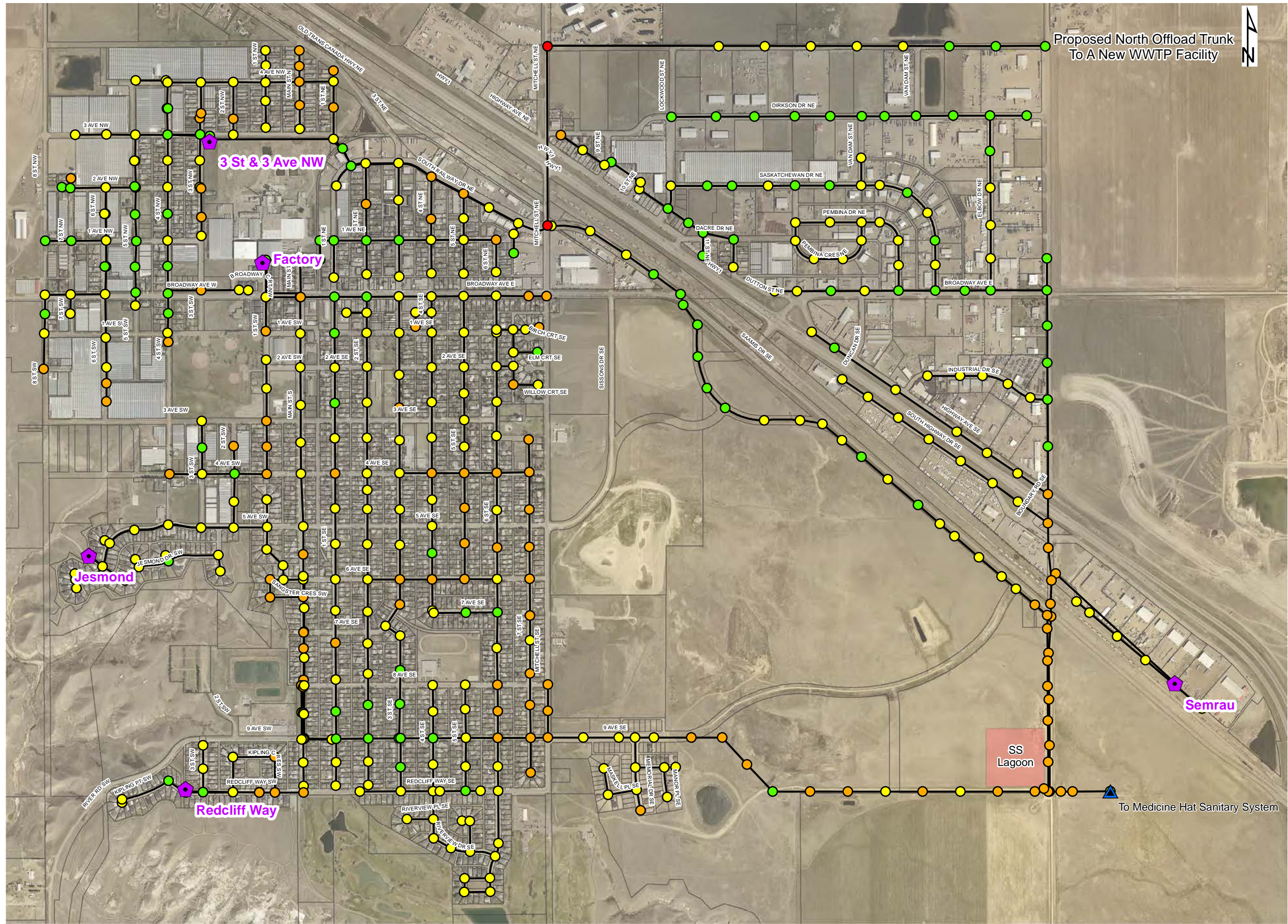


TOWN OF REDCLIFF  
SANITARY I-I STUDY  
CONCEPTUAL UPGRADES  
(WITH NORTH OFFLOAD TRUNK)  
FUTURE (UTIMATE) SYSTEM  
SCENARIO 2





FIGURE 8.9



## Legend

- Less Than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and -0.50m
- Greater Than 0.00m
- Lift Station

Sanitary Trunk

Surcharge  
Suppression Lagoon.  
Maximum Footprint of  
36,170 sq.m

1:12,500

0 50 100 200 300 400 Meters



### TOWN OF REDCLIFF SANITARY I-I STUDY

PEAK HGL RELATIVE TO GROUND  
(WITH NORTH OFFLOAD TRUNK)  
FUTURE (ULTIMATE) SYSTEM  
SCENARIO 2





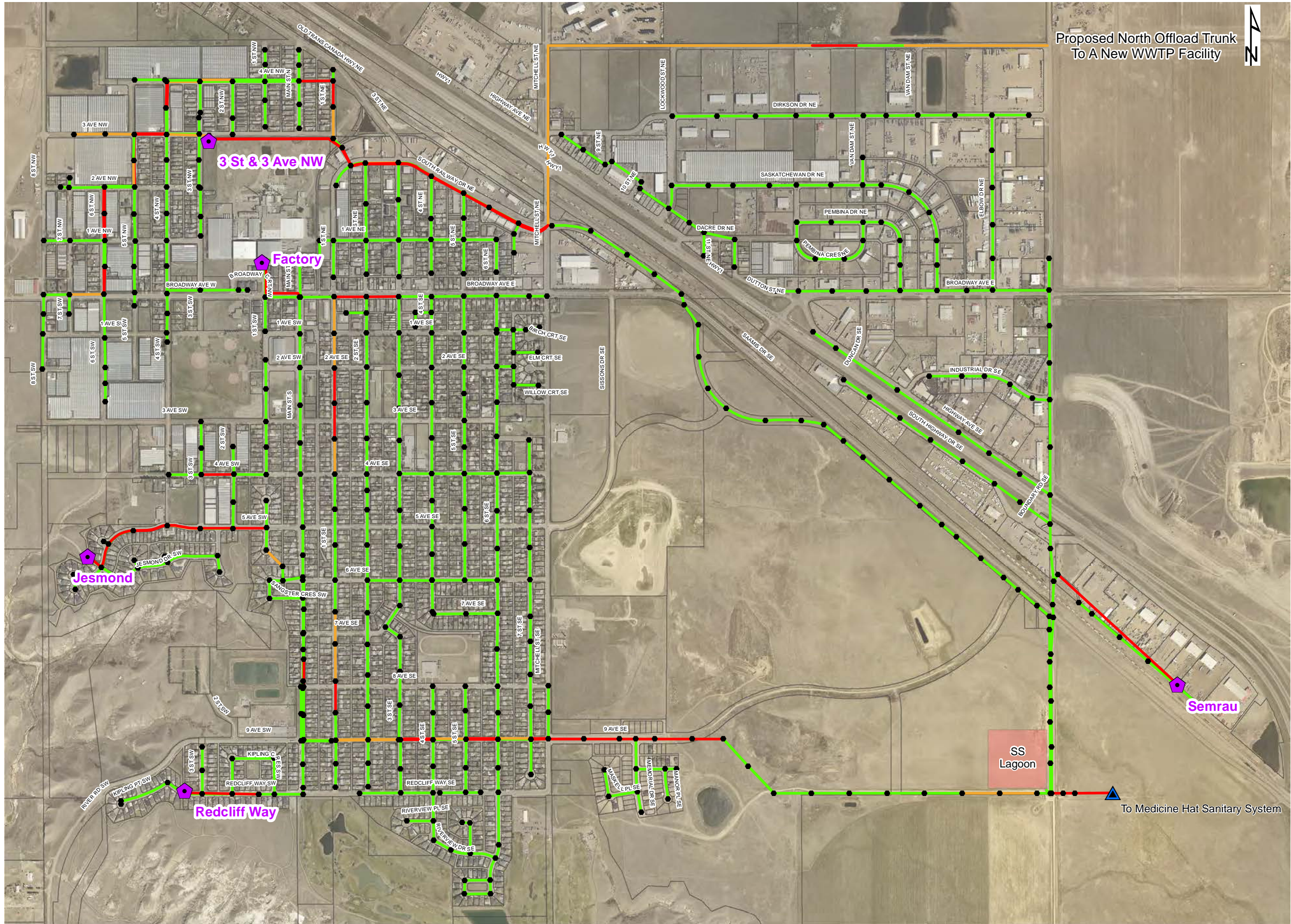
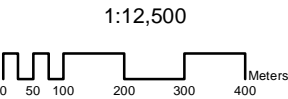


FIGURE 8.10

Legend

- Greater Than 100%
- Between 86% and 100%
- Less Than 86%
- Lift Station
- Surcharge Suppression Lagoon. Maximum Footprint of 36,170 sq.m



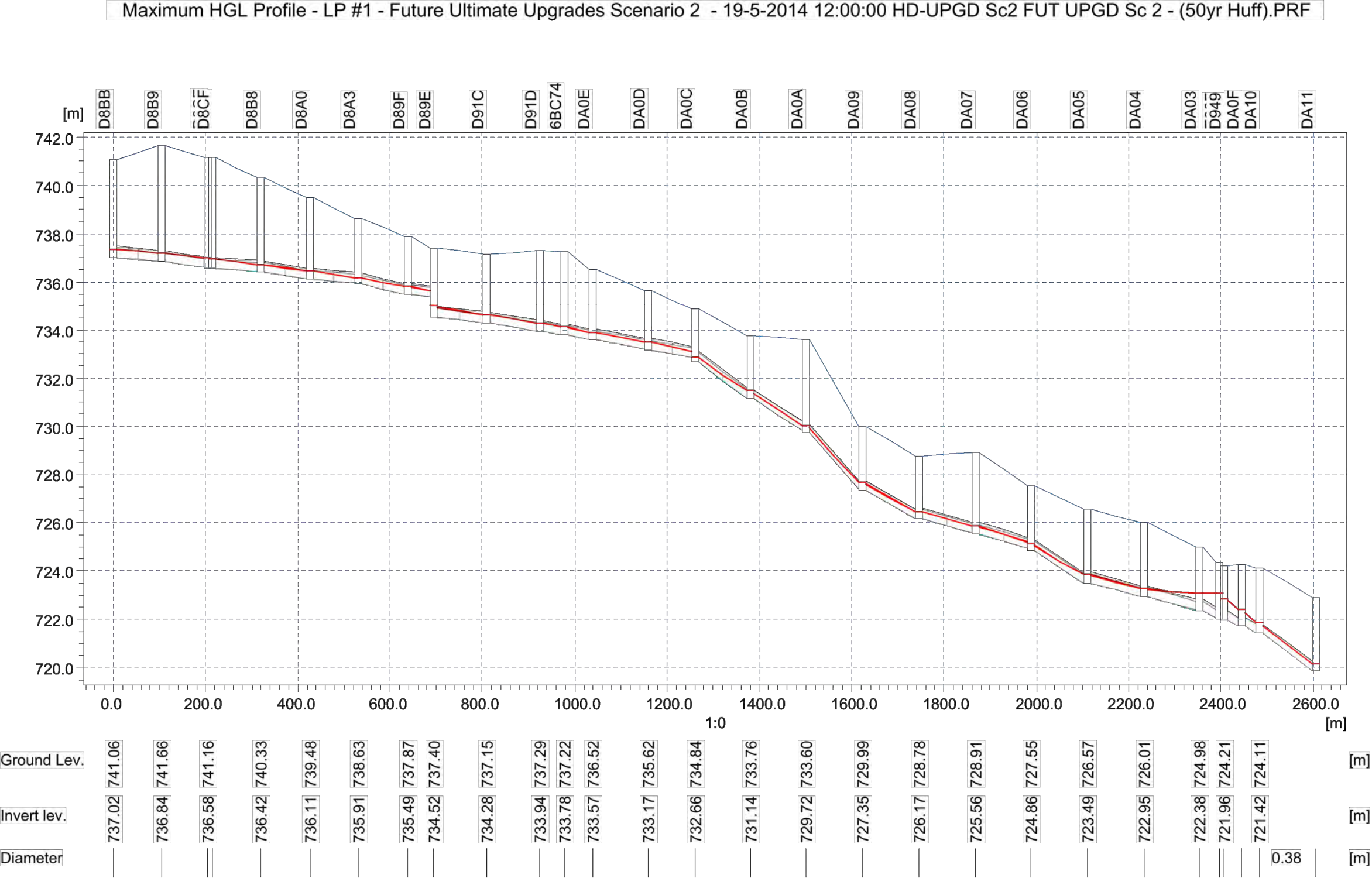
TOWN OF REDCLIFF  
SANITARY I-I STUDY  
PEAK DISCHARGE RELATIVE TO PIPE CAPACITY  
(WITH NORTH OFFLOAD TRUNK)  
FUTURE (ULTIMATE) SYSTEM  
SCENARIO 2





FIGURE 8.11.1

RAFAL JADZINSKI Apr. 7, 15 11:06:40 AM N:\26000\26031\_REDCLIFF\_SANITARY\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\FUT\_UPGRADES - SCENARIO 2\26031\_MAX\_HGL\_PROFILES - FUT ULT UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON & NORTH OFFLOAD) SCENARIO 2.DWG

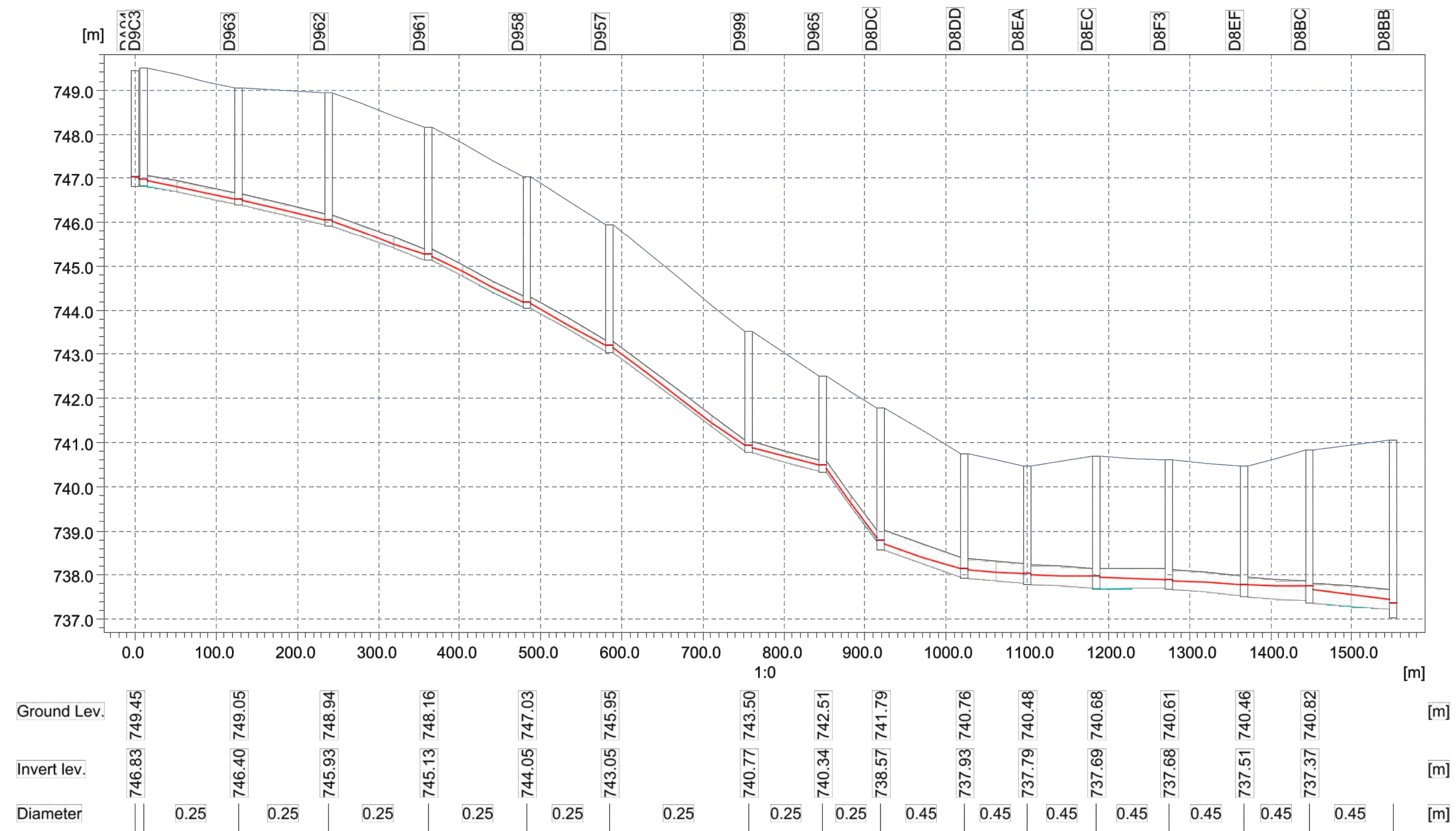


TOWN OF REDCLIFF  
SANITARY I-I STUDY  
FUTURE UPGRADES - SCENARIO 2  
NORTH OFFLOAD TRUNK & SS LAGOON  
MAXIMUM HGL PROFILE - LP #1



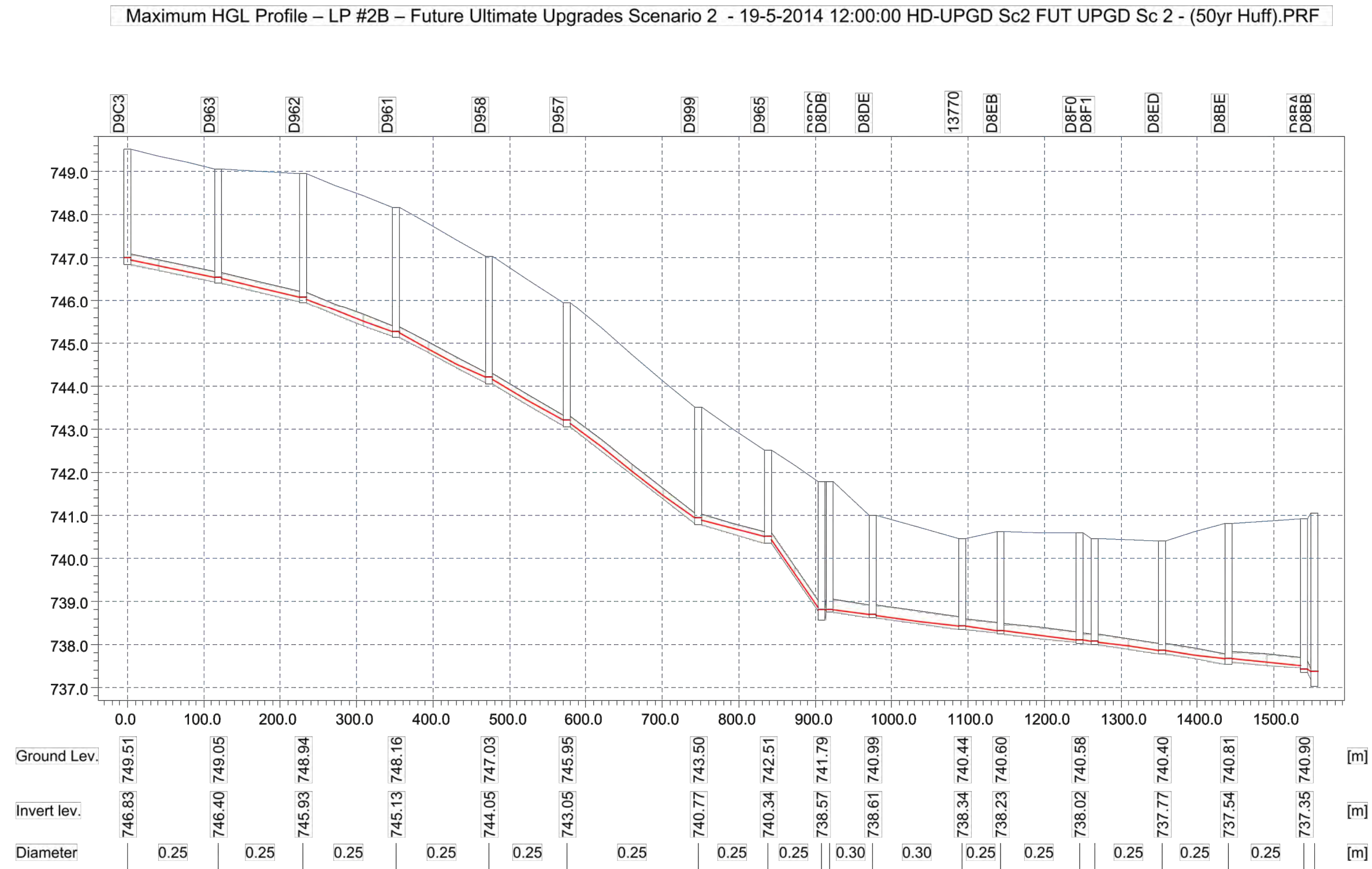
FIGURE 8.11.2

Maximum HGL Profile – LP #2A – Future Ultimate Upgrades Scenario 2 - 19-5-2014 12:00:00 HD-UPGD Sc2 FUT UPGD Sc 2 - (50yr Huff).PRF



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 2**  
**NORTH OFFLOAD TRUNK & SS LAGOON**  
**MAXIMUM HGL PROFILE - LP #2A**

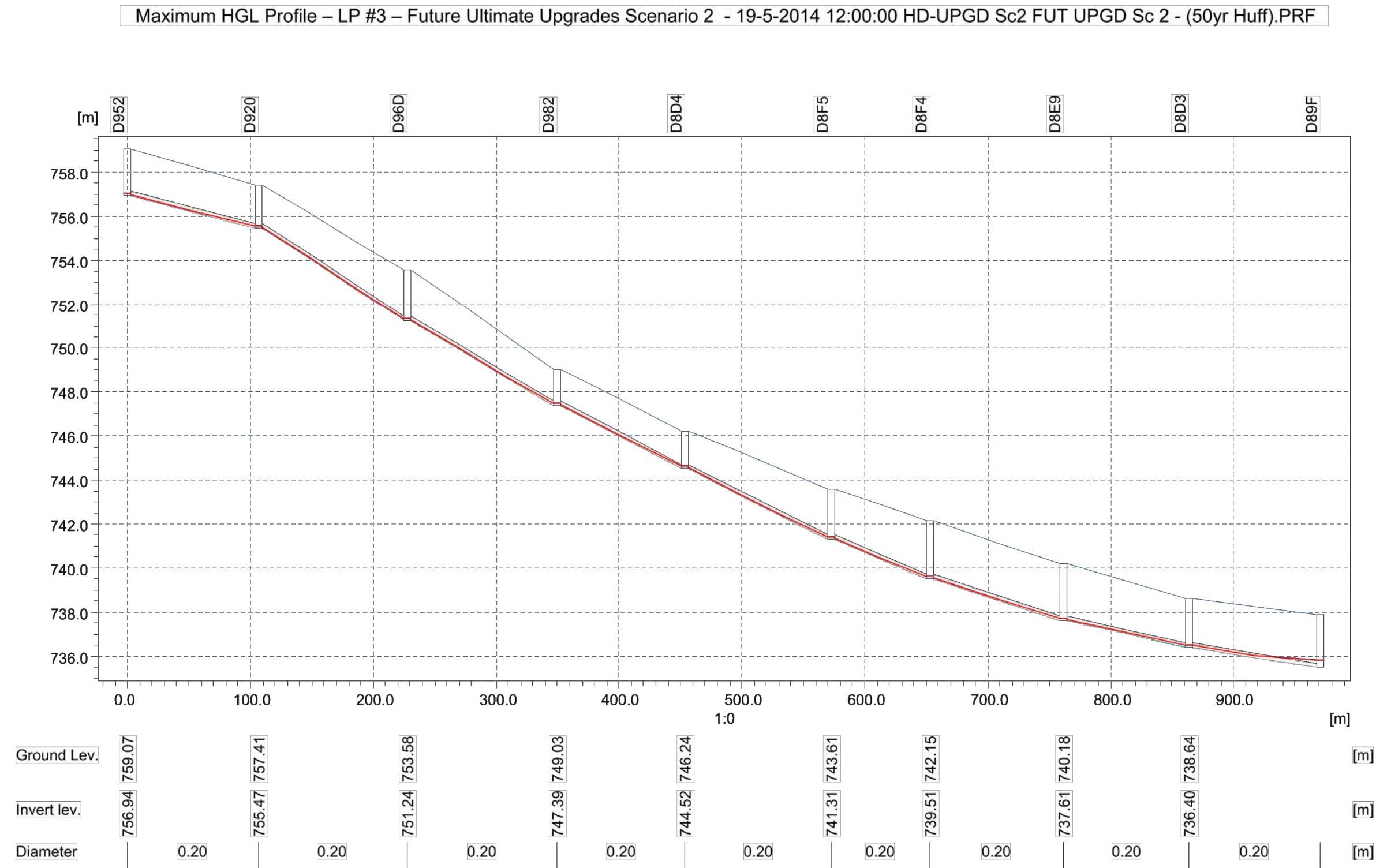
FIGURE 8.11.3



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 2**  
**NORTH OFFLOAD TRUNK & SS LAGOON**  
**MAXIMUM HGL PROFILE - LP #2B**

FIGURE 8.11.4

RAFAL\_JADZINSKI Apr. 7, 15 11:06:43 AM N:\26000\26031\_REDCLIFF\_SANITARY\_L\_L\_INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\IPS\FUT\_UPGRADES - SCENARIO 2\26031\_MAX\_HGL\_PROFILES - FUT ULT UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON & NORTH OFFLOAD) SCENARIO 2.DWG



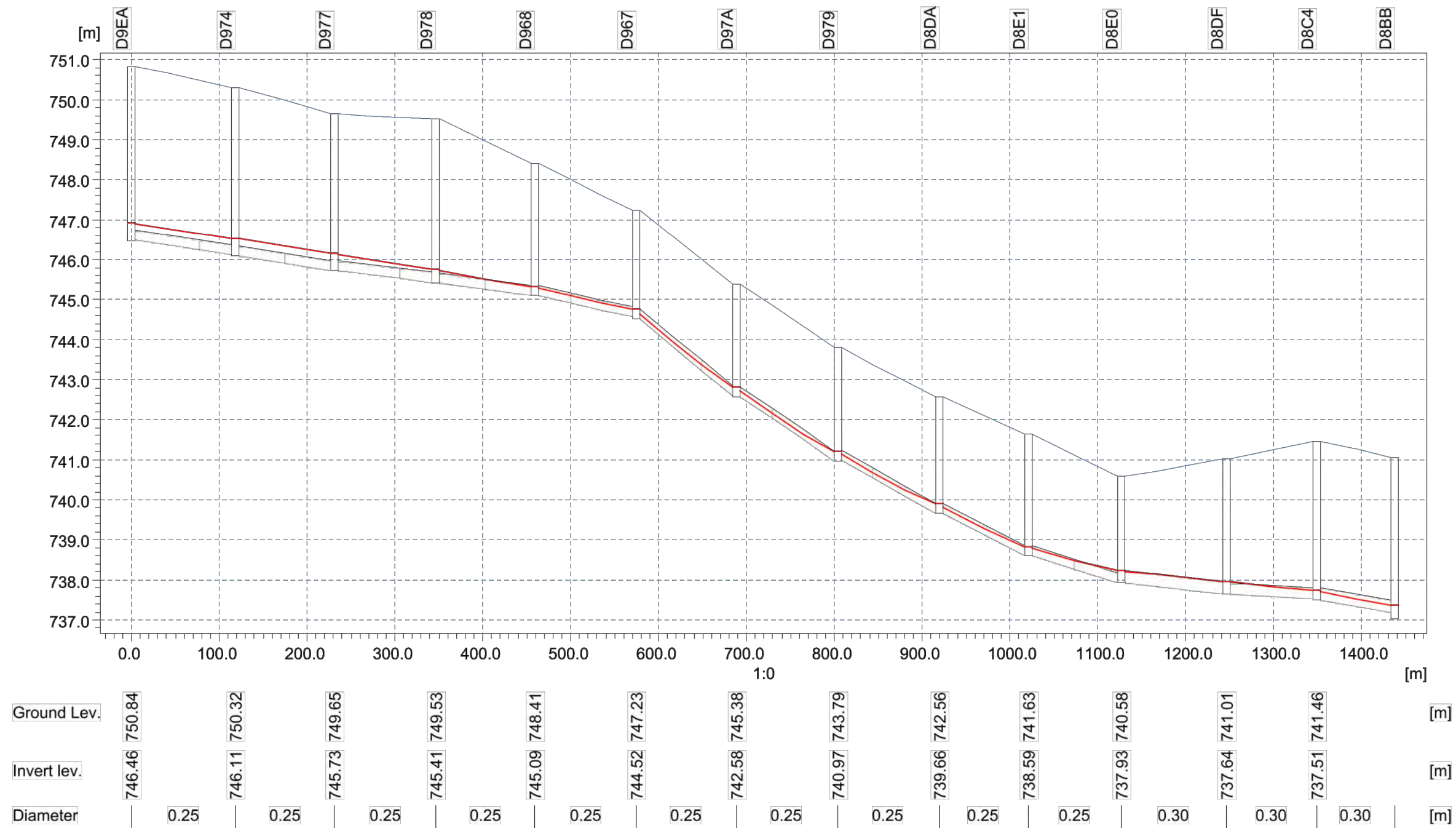
**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
FUTURE UPGRADES - SCENARIO 2  
NORTH OFFLOAD TRUNK & SS LAGOON  
MAXIMUM HGL PROFILE - LP #3





FIGURE 8.11.5

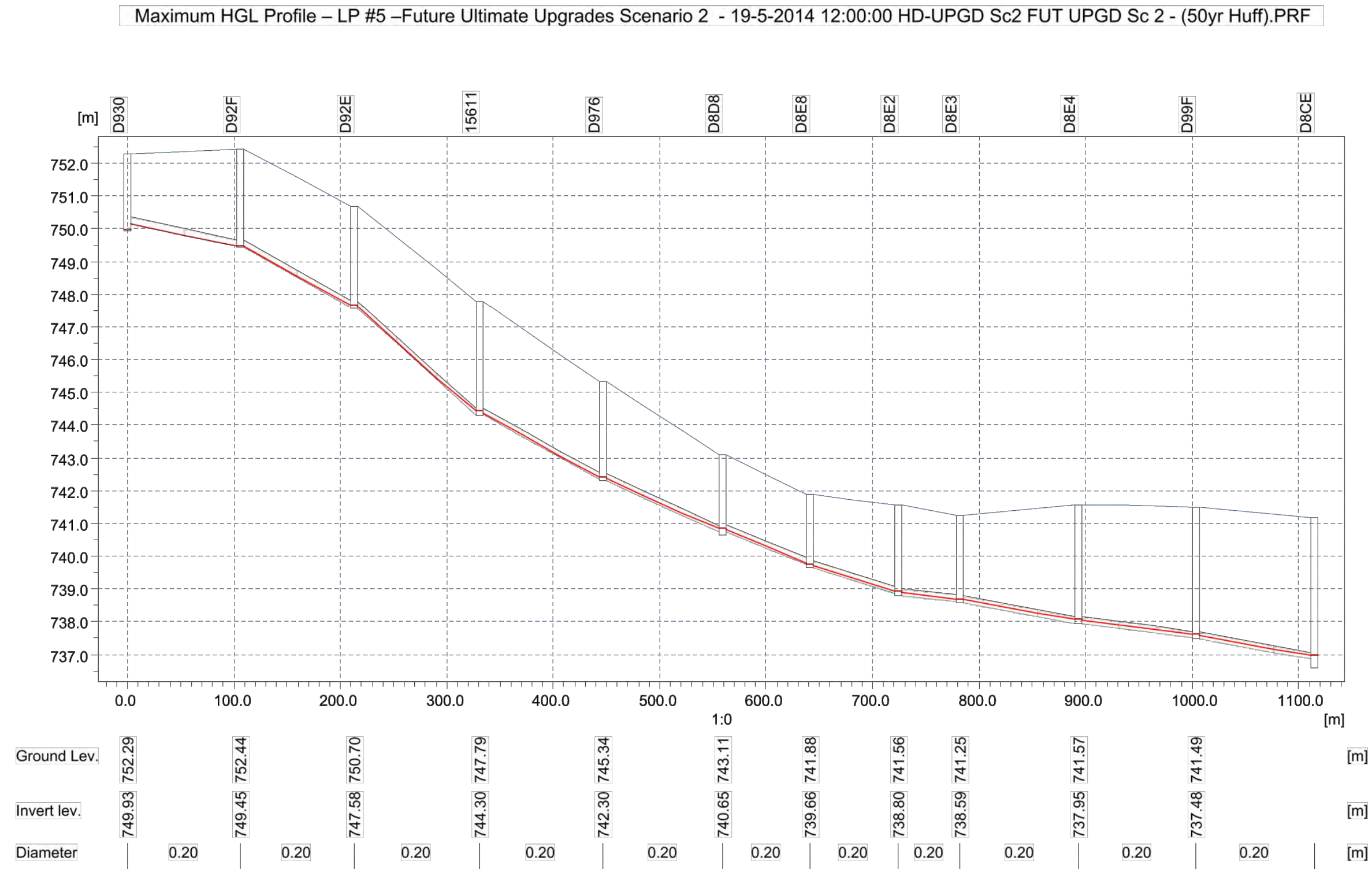
Maximum HGL Profile – LP #4 –Future Ultimate Upgrades Scenario 2 - 19-5-2014 12:00:00 HD-UPGD Sc2 FUT UPGD Sc 2 - (50yr Huff).PRF



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE UPGRADES - SCENARIO 2**  
**NORTH OFFLOAD TRUNK & SS LAGOON**  
**MAXIMUM HGL PROFILE - LP #4**

FIGURE 8.11.6

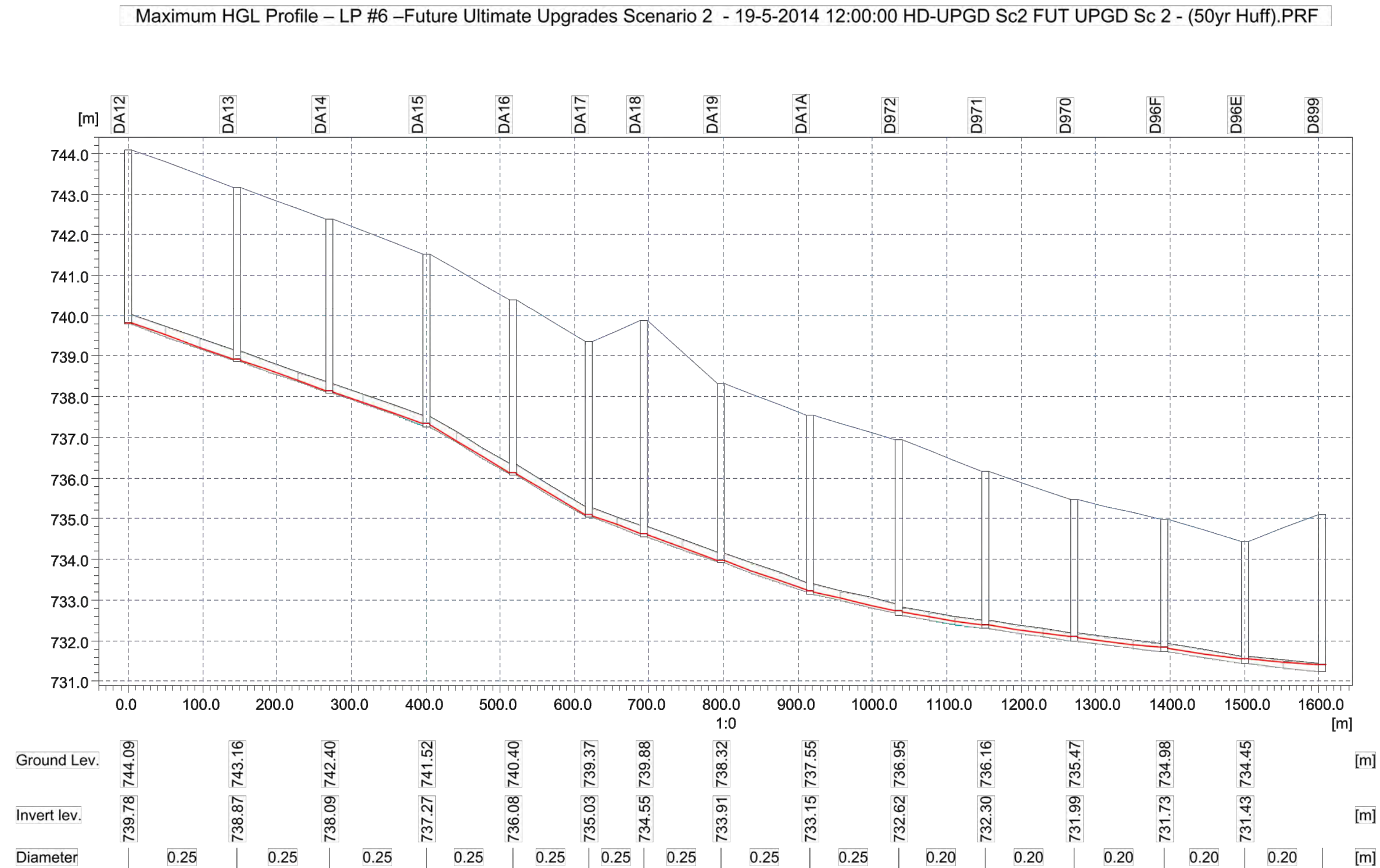
RAFAL\_JADZINSKI Apr. 7, 15 11:06:45 AM N:\26000\26031\_REDCLIFF\_SANITARY\_L\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\IPS\FUT\_UPGRADES - SCENARIO 2\26031\_MAX\_HGL\_PROFILES - FUT ULT UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON & NORTH OFFLOAD) SCENARIO 2.DWG



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE UPGRADES - SCENARIO 2**  
**NORTH OFFLOAD TRUNK & SS LAGOON**  
**MAXIMUM HGL PROFILE - LP #5**

FIGURE 8.11.7

RAFAL\_JADZINSKI Apr. 7, 15 11:06:46 AM N:\26000\26031\_REDCLIFF\_SANITARY\_L\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\FUT\_UPGRADES - SCENARIO 2\26031\_MAX\_HGL\_PROFILES - FUT ULT UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON & NORTH OFFLOAD) SCENARIO 2.DWG

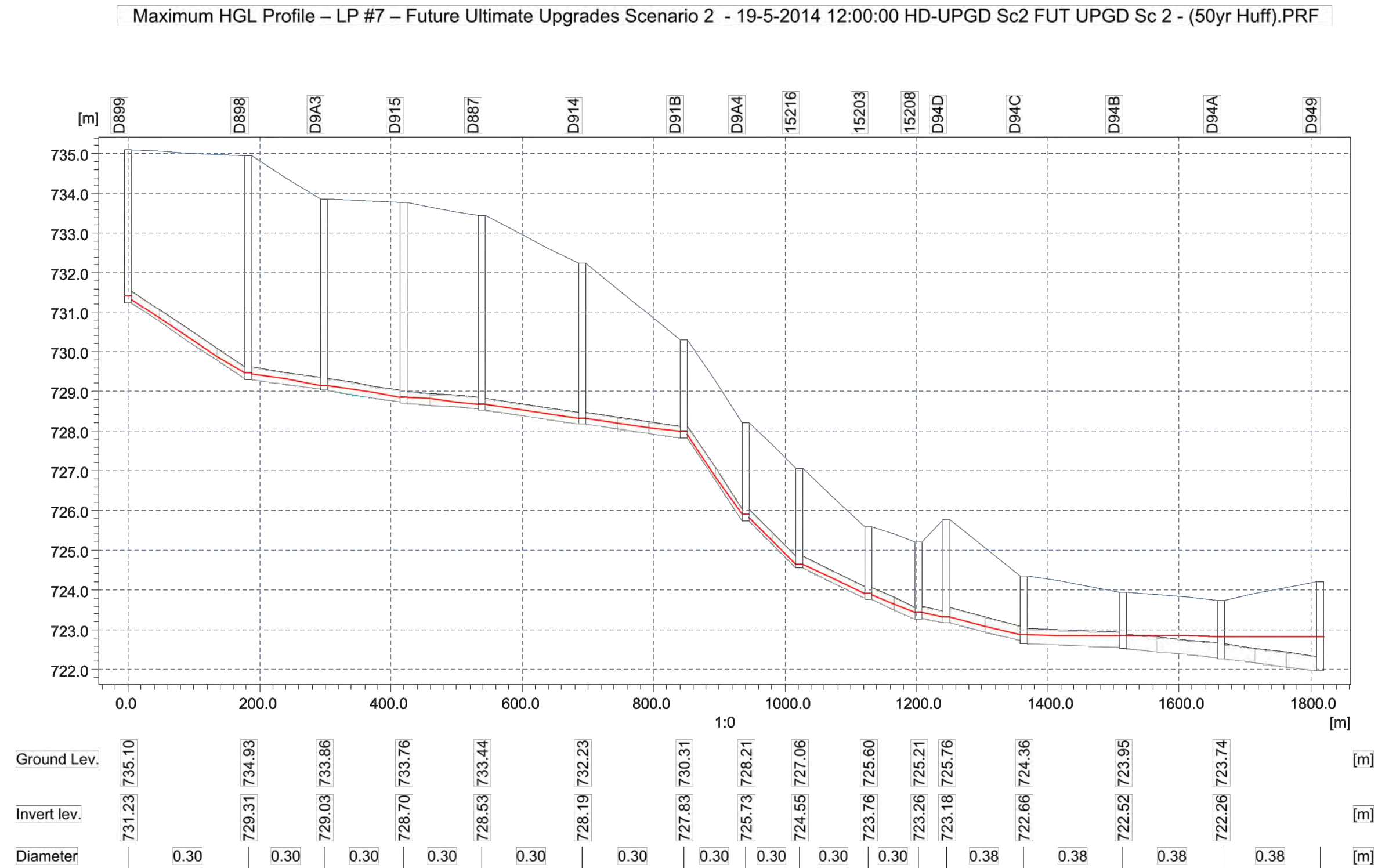


**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE UPGRADES - SCENARIO 2**  
**NORTH OFFLOAD TRUNK & SS LAGOON**  
**MAXIMUM HGL PROFILE - LP #6**



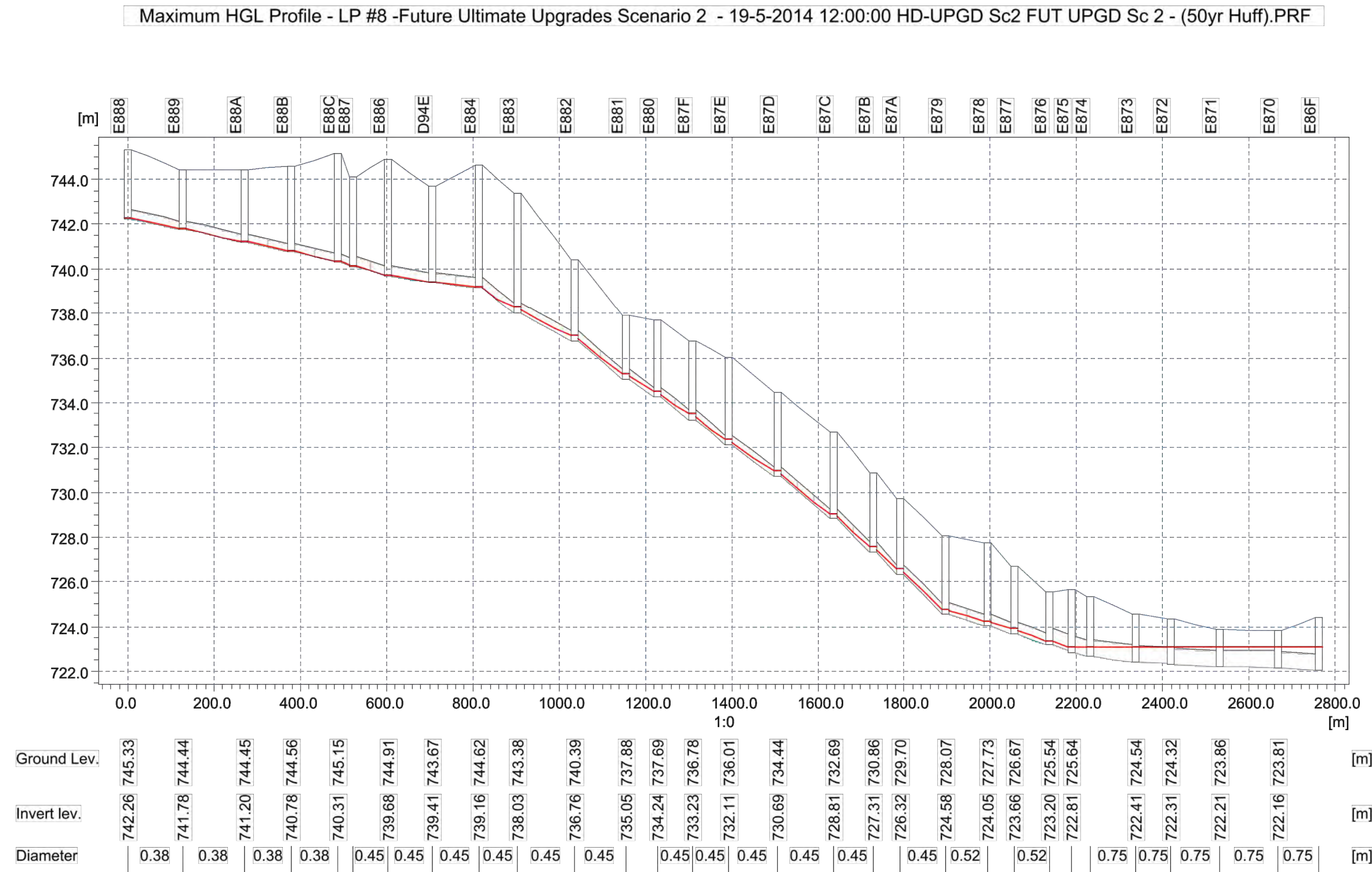
FIGURE 8.11.8

RAFAL\_JADZINSKI Apr. 7, 15 11:06:47 AM N:\26000\26031\_REDCLIFF\_SANITARY\_L\INVESTIGATION\02\_CADD\20\_DRAFTING\201\_FIGURES\PS\FUT\_UPGRADES - SCENARIO 2\26031\_MAX\_HGL\_PROFILES - FUT ULT UPGRADES 50YR 24HR HUFF Q4 STORM (SS LAGOON & NORTH OFFLOAD) SCENARIO 2.DWG



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 2**  
**NORTH OFFLOAD TRUNK & SS LAGOON**  
**MAXIMUM HGL PROFILE - LP #7**

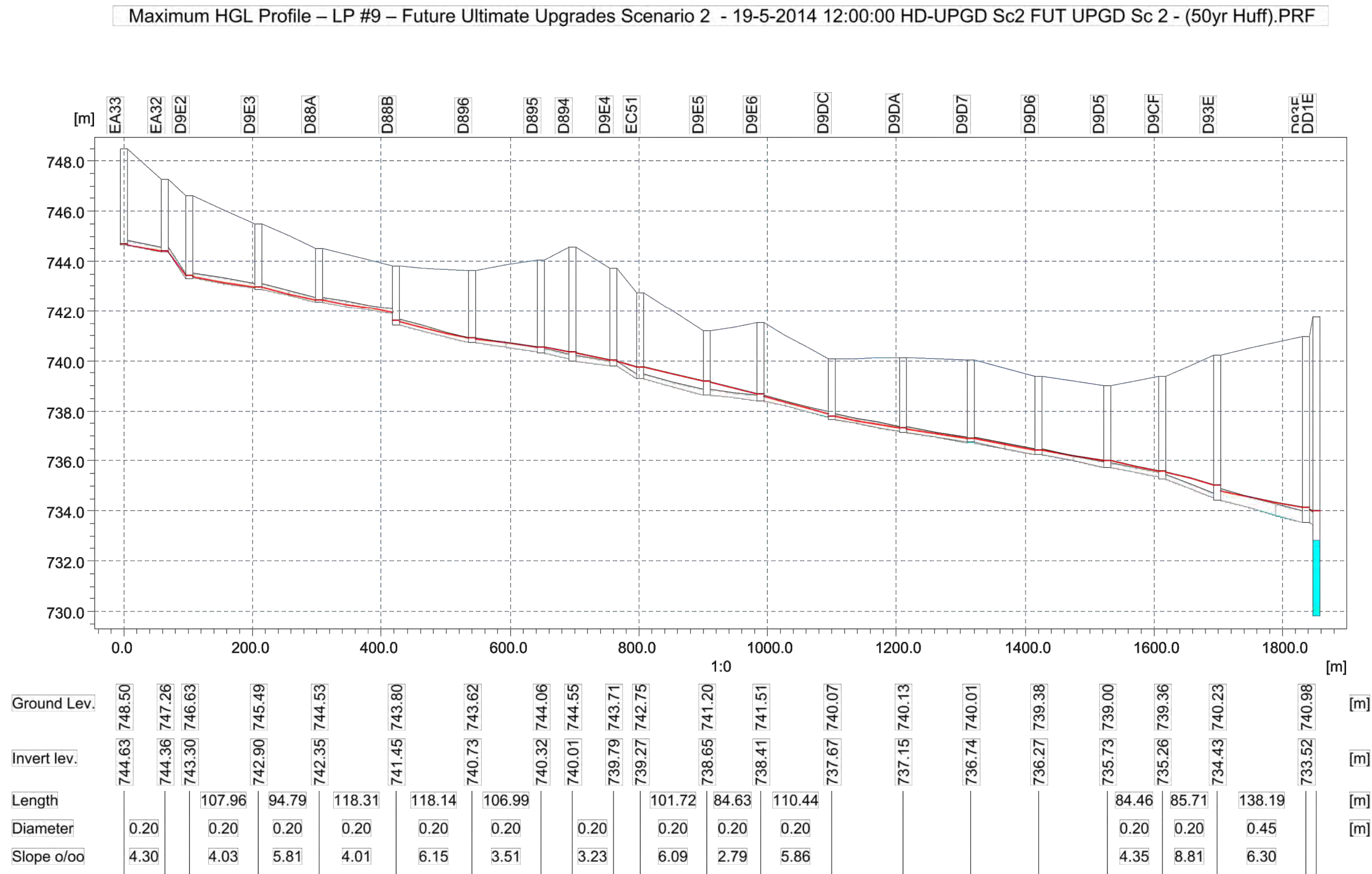
FIGURE 8.11.9



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 2**  
**NORTH OFFLOAD TRUNK & SS LAGOON**  
**MAXIMUM HGL PROFILE - LP #8**

FIGURE 8.11.10

RAFAL\_JADZINSKI Apr. 7, 15 11:06:50 AM N:\26000\26031\_REDCLIFF\_SANITARY\_LAGOON & NORTH OFFLOAD SCENARIO 2.DWG

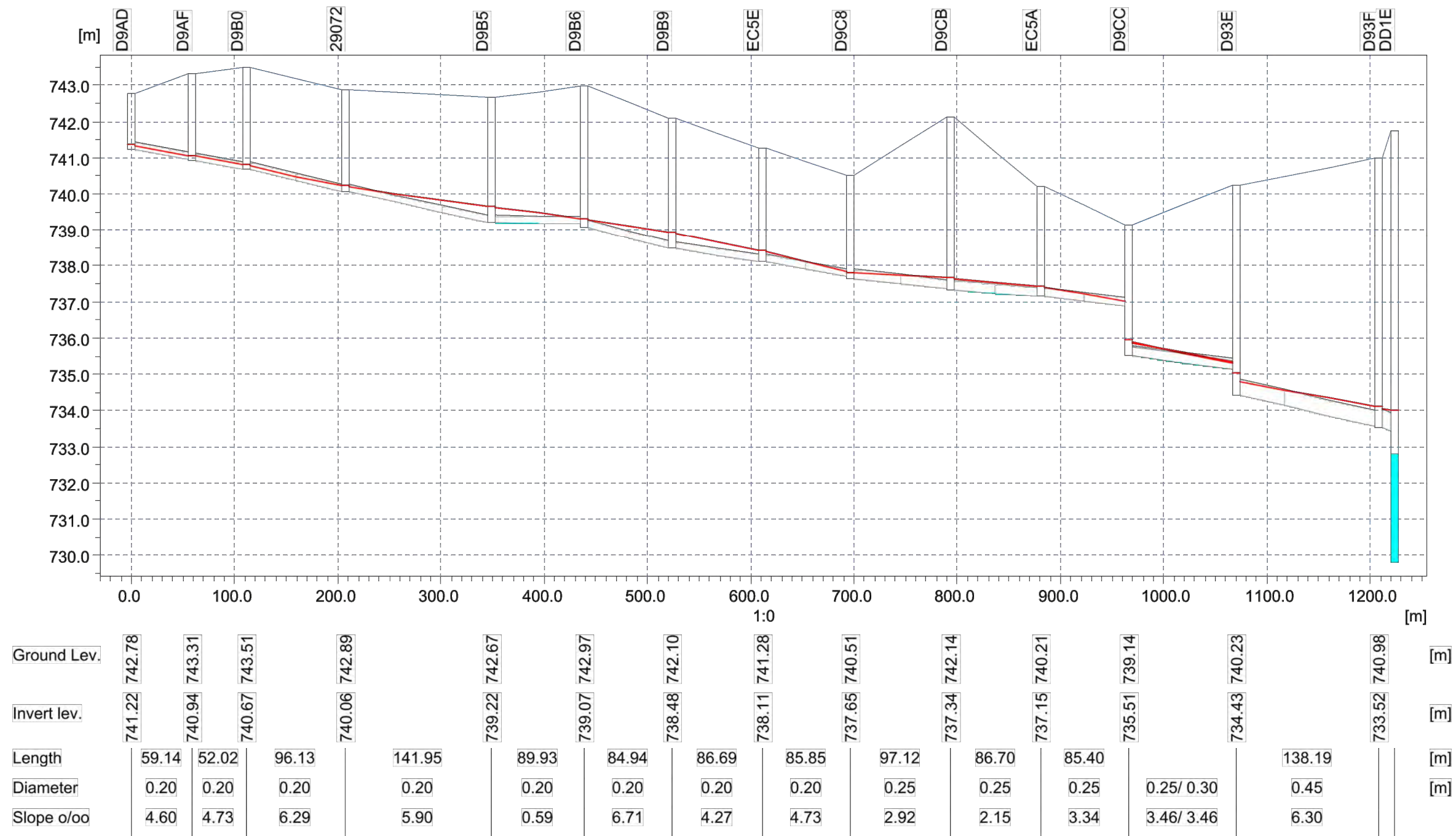


TOWN OF REDCLIFF  
SANITARY H STUDY  
FUTURE UPGRADES - SCENARIO 2  
NORTH OFFLOAD TRUNK & SS LAGOON  
MAXIMUM HGL PROFILE - LP #9



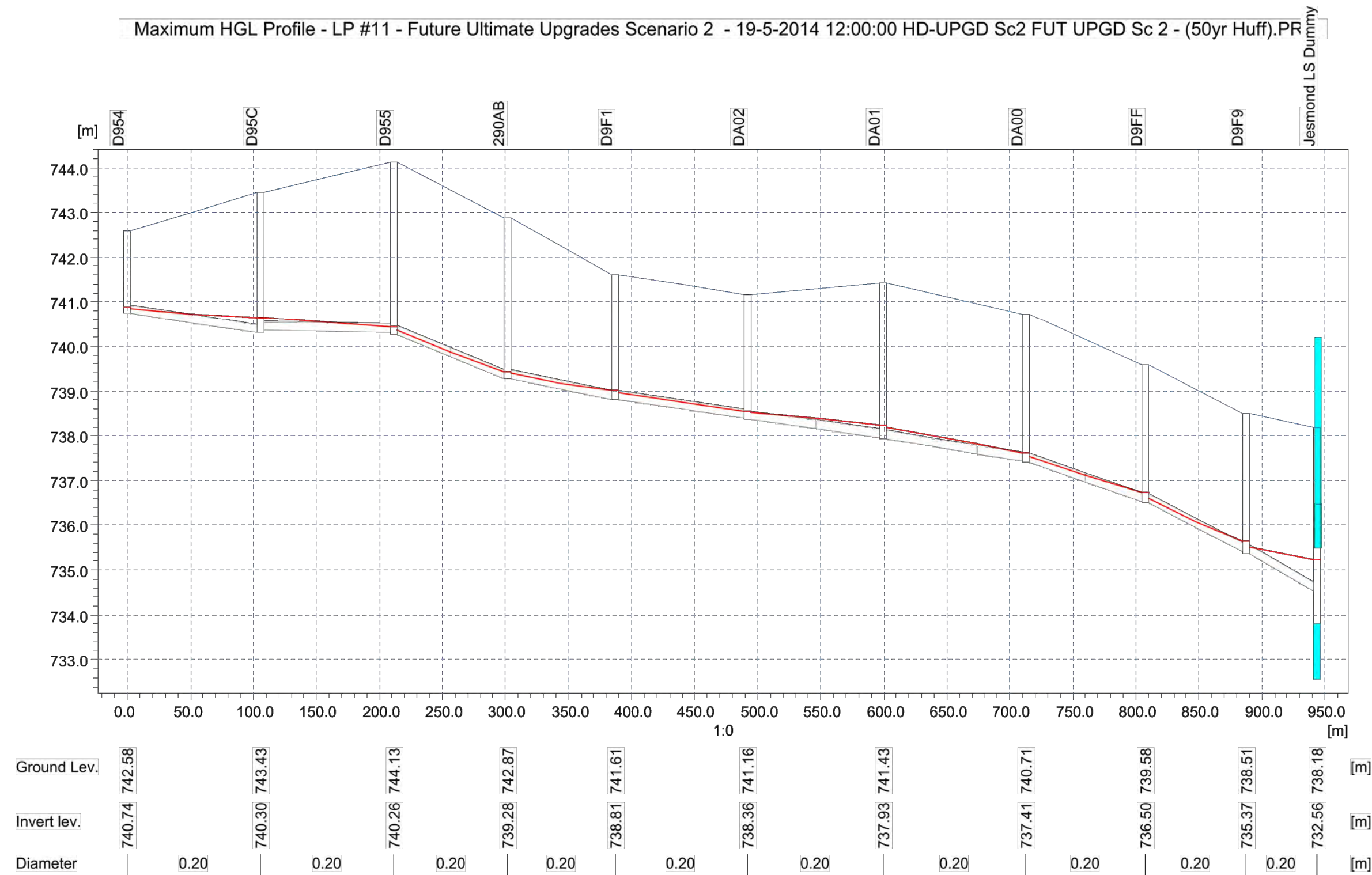
FIGURE 8.11.11

Maximum HGL Profile – LP #10 – Future Ultimate Upgrades Scenario 2 - 19-5-2014 12:00:00 HD-UPGD Sc2 FUT UPGD Sc 2 - (50yr Huff).PRF



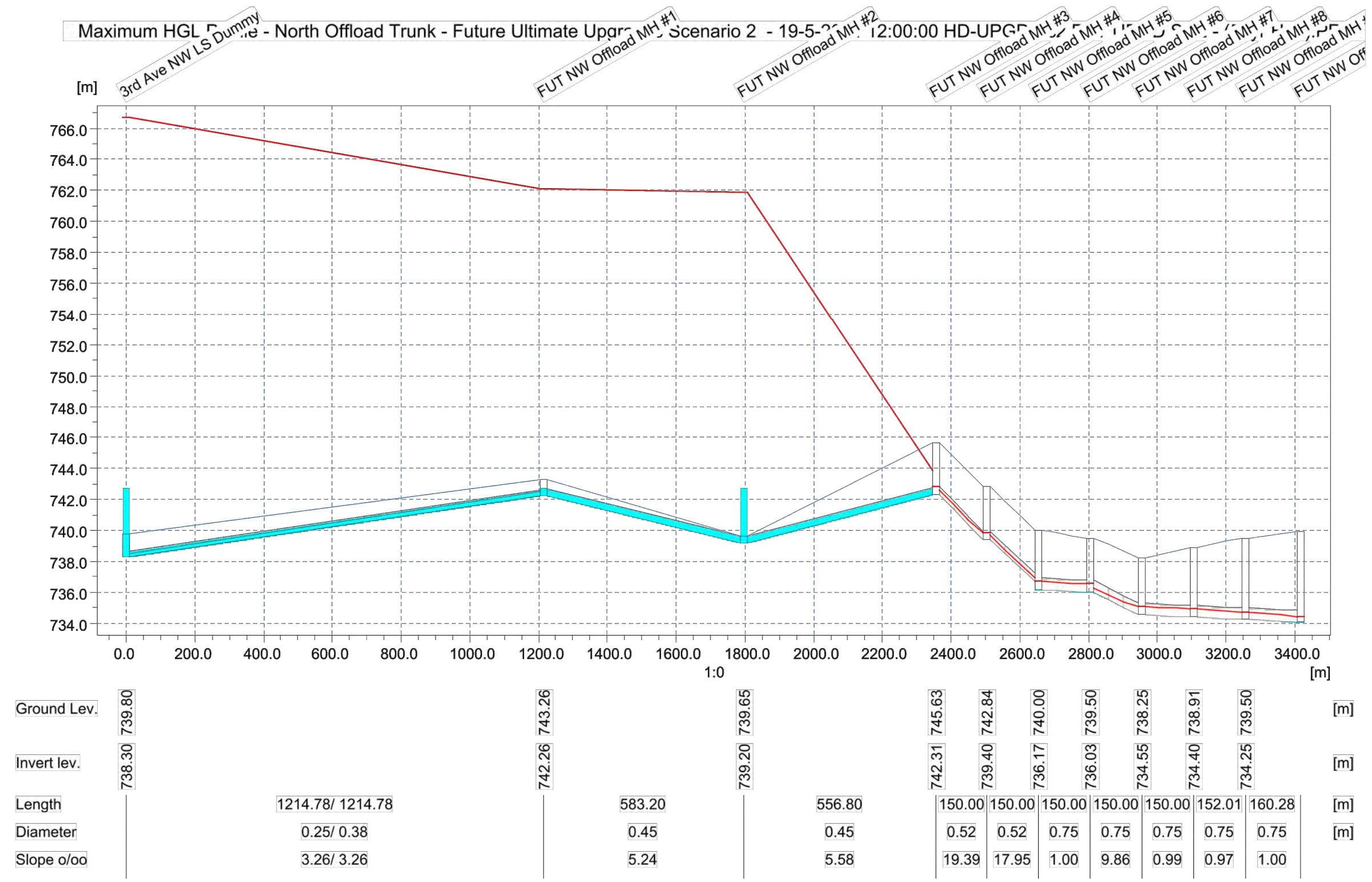
**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE UPGRADES - SCENARIO 2**  
**NORTH OFFLOAD TRUNK & SS LAGOON**  
**MAXIMUM HGL PROFILE - LP #10**

FIGURE 8.11.12



**TOWN OF REDCLIFF**  
**SANITARY I-I STUDY**  
**FUTURE UPGRADES - SCENARIO 2**  
**NORTH OFFLOAD TRUNK & SS LAGOON**  
**MAXIMUM HGL PROFILE - LP #11**

FIGURE 8.11.13



**TOWN OF REDCLIFF**  
**SANITARY H STUDY**  
**FUTURE UPGRADES - SCENARIO 2**  
**NORTH OFFLOAD TRUNK & SS LAGOON**  
**MAXIMUM HGL PROFILE - LP #N.O.T**

RAFAL JADZINSKI Apr. 7, 15 11:06:53 AM N:\26000\26031\_REDCLIFF\_SANITARY\_LAGOON & NORTH OFFLOAD SCENARIO 2.DWG



Table 4.1 – Dry Weather Calibration Summary

No.	Flow Monitor	DWF Period	Generalized Min. Flow (L/s)	Baseflow [80% of Min. Flow] (L/s)	Upstream Contributing Area (ha)	Baseflow Flow Rate (L/s/ha)	Residential DWF Rate (L/p/d)	Commercial		Horticultural		Industrial		Peak Flow			Volume		
								DWF Rate		DWF Rate		DWF Rate		Monitored (L/s)	Modelled (L/s)	Difference (%)	Monitored (m³)	Modelled (m³)	Difference (%)
								(L/ha/s)	(m³/ha/d)	(L/ha/s)	(m³/ha/d)	(L/ha/s)	(m³/ha/d)						
1	ISL D91B	June 23 - 26 2014	1.00	0.80	135.73	0.00589	n/a	0.06944	6.00	0.05468	4.72	0.01157	1.00	7.00	5.55	-20.71	669.34	795.15	18.80
2	ISL DA0E	May 17 - 24 2014	7.50	6.00	166.79	0.03597	200	0.05787	5.00	0.05468	4.72	0.01157	1.00	33.00	32.00	-3.03	10703.15	11772.81	9.99
3	ISL D93F <sup>1</sup>	May 17 - 24 2014	5.50	4.40	70.34	0.06255	200	0.06944	6.00	0.20000	17.28	0.01157	1.00	26.00	24.00	-7.69	9300.59	8476.95	-8.86
4	Non-FMed <sup>2</sup>	May 1- 8 2013	n/a	0.80	26.93	0.02970	n/a	0.06944	6.00	n/a		0.01157	1.00	n/a					

Note:  
<sup>1</sup> - Some rainfall was observed on May 19 2014 which is reflected in the observed flows spiking at about 12:35PM and 19:20PM. These spikes were disregarded for the purpose of DWF calibration. Please note that five days within a 7-day calibration period were very well replicated.  
<sup>2</sup> - Baseflow and DWF rates based on Site D91B due to similar land use characteristics

- generalized peak flow

Table 7.2 – Existing System Huff Storm Upgrades

Cost Estimates of Conceptual Sanitary Upgrades - Based on 50-yr 24-hr 4th Quartile Huff Storm Event							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
200mm Trunk Sewers	1,313	meters	\$310/m	\$406,893	\$122,068	\$61,034	\$589,995
250mm Trunk Sewers	573	meters	\$335/m	\$183,510	\$55,053	\$27,527	\$266,090
300mm Trunk Sewers	1,625	meters	\$350/m	\$568,876	\$170,663	\$85,331	\$824,870
375mm Trunk Sewers	567	meters	\$400/m	\$226,616	\$67,985	\$33,992	\$328,594
450mm Trunk Sewers	0	meters	\$480/m	\$0	\$0	\$0	\$0
525mm Trunk Sewers	0	meters	\$545/m	\$0	\$0	\$0	\$0
675mm Trunk Sewers	0	meters	\$730/m	\$0	\$0	\$0	\$0
Set of Pumps (3rd Ave LS - 115L/s)	1	set	\$600,000	\$600,000	\$180,000	\$90,000	\$870,000
Set of Pumps (Jasmond LS - 80L/s)	1	set	\$600,000	\$600,000	\$180,000	\$90,000	\$870,000
Forcemain (3rd Ave LS - 250mm)	1,215	meters	\$450/m	\$546,750	\$164,025	\$82,013	\$792,788
Pavement Rehabilitation	3,567	meters	\$750/m	\$2,675,363	\$802,609	\$401,304	\$3,879,277
Grand - Total:				\$5,808,009	\$1,742,403	\$871,201	\$8,421,613

Table 7.3 – Existing System Thunderstorm Upgrades

Cost Estimates of Conceptual Sanitary Upgrades - Based on July 6 2013 Thunderstorm Event							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
200mm Trunk Sewers	1,267	meters	\$310/m	\$392,663	\$117,799	\$58,899	\$569,361
250mm Trunk Sewers	2,361	meters	\$335/m	\$755,665	\$226,700	\$113,350	\$1,095,715
300mm Trunk Sewers	1,819	meters	\$350/m	\$636,673	\$191,002	\$95,501	\$923,176
375mm Trunk Sewers	925	meters	\$400/m	\$370,162	\$111,049	\$55,524	\$536,735
450mm Trunk Sewers	3,548	meters	\$480/m	\$1,703,009	\$510,903	\$255,451	\$2,469,364
525mm Trunk Sewers	1,794	meters	\$545/m	\$977,642	\$293,293	\$146,646	\$1,417,582
675mm Trunk Sewers	814	meters	\$730/m	\$508,912	\$152,674	\$76,337	\$737,922
Lift Station (3rd Ave LS - 560L/s)	1	set	\$5,000,000 each	\$5,000,000	\$1,500,000	\$750,000	\$7,250,000
Set of Pumps (Jasmond LS - 80L/s)	1	set	\$600,000	\$600,000	\$180,000	\$90,000	\$870,000
Forcemain (3rd Ave LS - 525mm)	1,215	meters	\$650/m	\$789,608	\$236,882	\$118,441	\$1,144,931
Forcemain (Jasmond LS - 250mm)	665	meters	\$450/m	\$299,115	\$89,735	\$44,867	\$433,717
Pavement Rehabilitation	10,286	meters	\$750/m	\$7,714,648	\$2,314,394	\$1,157,197	\$11,186,239
Grand - Total:				\$19,748,098	\$5,924,429	\$2,962,215	\$28,634,741

Table 7.4 – Existing System – Medicine Hat Twinned Sewer Upgrade

High Level (Conceptual) Cost Estimate For Twinning Existing Sewer Line To Medicine Hat							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
450mm Sanitary Trunk - Open Cut	1,943	meters	\$473	\$918,146.96	\$275,444	\$137,722	\$1,340,000
450mm Sanitary Trunk - Trenchless	313	meters	\$2,500	\$781,794	\$234,538	\$117,269	\$1,140,000
Trenchless Pits	2	pair	\$20,000	\$40,000	\$12,000	\$6,000	\$60,000
Type 5A 1.2m dia Manhole	60	v. meter	\$2,250	\$135,342.63	\$40,603	\$20,301	\$200,000
Grand - Total:				\$1,875,284	\$562,585	\$281,293	\$2,740,000

Table 7.5 – Existing System Box Storage Upgrade

High Level (Conceptual) Cost Estimate of Underground Sewage Overflow Storage For The Town of Redcliff															
Underground Storage (Span x Rise)	Stripping			Excavation			Box Section				Lift Station	Subtotal	Contingency	Engineering Fee	Total Cost
	Area	Unit Cost	Cost	Volume	Unit Cost	Cost	Length	Storage Volume	Unit Cost	Cost	(Capacity of 100L/s)				
	(m²)	(\$/m²)	(\$)	(m²)	(\$/m²)	(\$)	(m)	(m³)	(\$/unit )	(\$)	(\$)	(\$)	30%	15%	(\$)
3.0m x 2.4m	33,938	2.00	\$67,875	110,587	10.00	\$1,105,866	905	6,403	\$4,135	\$3,742,175	\$3,000,000	\$7,915,916	\$2,374,775	\$1,187,387	\$11,478,078



Table 8.3 – Future System Option 1 Conveyance Upgrades – Discharge to SE Sewer / Medicine Hat

Cost Estimates of Conceptual Future Ultimate Sanitary Upgrades (50yr Huff with Inflow Hydrographs For Future Areas) - SCENARIO 1							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
200mm Trunk Sewers	1,142	meters	\$310/m	\$354,142	\$106,243	\$53,121	\$513,506
250mm Trunk Sewers	640	meters	\$335/m	\$214,308	\$64,292	\$32,146	\$310,747
300mm Trunk Sewers	300	meters	\$350/m	\$105,145	\$31,544	\$15,772	\$152,461
375mm Trunk Sewers	2,556	meters	\$400/m	\$1,022,402	\$306,721	\$153,360	\$1,482,483
450mm Trunk Sewers	2,285	meters	\$480/m	\$1,096,643	\$328,993	\$164,496	\$1,590,132
525mm Trunk Sewers	0	meters	\$545/m	\$0	\$0	\$0	\$0
675mm Trunk Sewers	0	meters	\$730/m	\$0	\$0	\$0	\$0
Set of Pumps For 3rd Ave LS	1	set	\$600,000	\$600,000	\$180,000	\$90,000	\$870,000
Set of Pumps For Jasmond LS	1	set	\$600,000	\$600,000	\$180,000	\$90,000	\$870,000
Forcemain (3rd Ave LS - 525mm)	1,215	meters	\$650/m	\$789,608	\$236,882	\$118,441	\$1,144,931
Pavement Rehabilitation	6,487	meters	\$750/m	\$4,865,055	\$1,459,517	\$729,758	\$7,054,330
Grand - Total:				\$9,647,303	\$2,894,191	\$1,447,095	\$13,988,589

Table 8.4 – Future System Option 2 Conveyance Upgrades – North Plant / Lagoon

Cost Estimates of Conceptual Future Ultimate Sanitary Upgrades (50yr Huff with Inflow Hydrographs For Future Areas) - SCENARIO 2							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
200mm Trunk Sewers	1,142	meters	\$310/m	\$354,142	\$106,243	\$53,121	\$513,506
250mm Trunk Sewers	640	meters	\$335/m	\$214,308	\$64,292	\$32,146	\$310,747
300mm Trunk Sewers	300	meters	\$350/m	\$105,145	\$31,544	\$15,772	\$152,461
375mm Trunk Sewers	1,742	meters	\$400/m	\$696,699	\$209,010	\$104,505	\$1,010,213
450mm Trunk Sewers	652	meters	\$480/m	\$313,095	\$93,929	\$46,964	\$453,988
525mm Trunk Sewers	0	meters	\$545/m	\$0	\$0	\$0	\$0
675mm Trunk Sewers	0	meters	\$730/m	\$0	\$0	\$0	\$0
750mm Trunk Sewers	1,062	meters	\$815/m	\$865,767	\$259,730	\$129,865	\$1,255,362
Set of Pumps For 3rd Ave LS	1	set	\$600,000	\$600,000	\$180,000	\$90,000	\$870,000
Set of Pumps For Jasmond LS	1	set	\$600,000	\$600,000	\$180,000	\$90,000	\$870,000
Forcemain (3rd Ave LS - 525mm)	1,215	meters	\$650/m	\$789,608	\$236,882	\$118,441	\$1,144,931
Forcemain (Extension of 3rd Ave FM - 600mm)	1,140	meters	\$750/m	\$855,002	\$256,501	\$128,250	\$1,239,753
Pavement Rehabilitation	6,533	meters	\$750/m	\$4,900,078	\$1,470,023	\$735,012	\$7,105,113
Grand - Total:				\$10,293,844	\$3,088,153	\$1,544,077	\$14,926,074

Table 8.5 – Future System – Medicine Hat Twinned Sewer Upgrade

High Level (Conceptual) Cost Estimate For Twinning Existing Sewer Line To Medicine Hat							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
675mm Sanitary Trunk - Open Cut	1,943	meters	\$750	\$1,457,000	\$437,000	\$219,000	\$2,113,000
675mm Sanitary Trunk - Trenchless	313	meters	\$2,500	\$783,000	\$235,000	\$117,000	\$1,135,000
Trenchless Pits	2	pair	\$20,000	\$40,000	\$12,000	\$6,000	\$60,000
Type 5A 1.2m dia Manhole	60	v. meter	\$2,250	\$135,000	\$41,000	\$20,000	\$196,000
Grand - Total:				\$2,415,000	\$725,000	\$362,000	\$3,504,000

Table 8.6 – Future System Option 1 SE Pump Station to Avoid Twinning to Medicine Hat

High Level Cost Estimate For Pumping Excess Sanitary Flow From South Trunk - FUTURE BUILD-OUT SCENARIO							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
Lift Station (Q <sub>peak</sub> of 435L/s)	1	each	\$5,170,000	\$5,170,000	\$1,551,000	\$775,500	\$7,500,000
600mm Forcemain - Open Cut	2,050	meters	\$650	\$1,332,500	\$399,750	\$199,875	\$1,940,000
600mm Forcemain - Trenchless w/ Sleeve	400	meters	\$2,000	\$800,000	\$240,000	\$120,000	\$1,160,000
Trenchless Pits	2	pair	\$20,000	\$40,000	\$12,000	\$6,000	\$60,000
Pavement Rehabilitation	1,500	l. meters	\$750	\$1,125,000	\$337,500	\$168,750	\$1,640,000
Grand - Total:				\$8,467,500	\$2,540,250	\$1,270,125	\$12,300,000

Table 8.7 – Future System Option 2 SE Pump Station to Avoid Twinning to Medicine Hat

High Level Cost Estimate For Pumping Excess Sanitary Flow From South Trunk FUTURE BUILD-OUT SCENARIO WITH NORTH OFFLOAD TRUNK							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
Lift Station (Q <sub>peak</sub> of 210L/s)	1	each	\$3,445,000	\$3,445,000	\$1,033,500	\$516,750	\$5,000,000
450mm Forcemain - Open Cut	2,050	meters	\$550	\$1,127,500	\$338,250	\$169,125	\$1,640,000
450mm Forcemain - Trenchless w/ Sleeve	400	meters	\$1,900	\$760,000	\$228,000	\$114,000	\$1,110,000
Trenchless Pits	2	pair	\$20,000	\$40,000	\$12,000	\$6,000	\$60,000
Pavement Rehabilitation	1,500	l. meters	\$750	\$1,125,000	\$337,500	\$168,750	\$1,640,000
Grand - Total:				\$6,497,500	\$1,949,250	\$974,625	\$9,450,000

Table 8.8 – Future System Option– Outfall Sewer from North Lagoon

High Level (Conceptual) Cost Estimate For Outfall Pipe From Future North Lagoon							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
525mm Sanitary Trunk (Discharge of 260L/s)	5,400	meters	\$545	\$2,942,973	\$882,892	\$441,446	\$4,270,000
Type 5A 1.2m dia Manhole	144	v. meter	\$2,250	\$324,000	\$97,200	\$48,600	\$470,000
Outfall Structure	1	each	\$100,000	\$100,000	\$30,000	\$15,000	\$145,000
Grand - Total:				\$3,366,973	\$1,010,092	\$505,046	\$4,885,000

Table 8.9 – Future System Option – Outfall Sewer from North WWTP

High Level (Conceptual) Cost Estimate For Outfall Pipe From Future Wastewater Treatment plant							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
450mm Sanitary Trunk (Discharge of 200L/s)	5,400	meters	\$480	\$2,592,000	\$777,600	\$388,800	\$3,760,000
Type 5A 1.2m dia Manhole	144	v. meter	\$2,250	\$324,000	\$97,200	\$48,600	\$470,000
Outfall Structure	1	each	\$100,000	\$100,000	\$30,000	\$15,000	\$145,000
Grand - Total:				\$3,016,000	\$904,800	\$452,400	\$4,375,000



Table 8.10 – Future System Option – Outfall Sewer from SE Plant to South Saskatchewan

High Level (Conceptual) Cost Estimate For Outfall Pipe From Future Wastewater Treatment plant							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
675mm Sanitary Trunk (Discharge of 500L/s)	1,600	meters	\$750	\$1,200,000	\$360,000	\$180,000	\$1,740,000
675mm Trunk – Trenchless (Down Escarpment)	500	meters	\$2,500	\$1,250,000	\$375,000	\$188,000	\$1,813,000
Type 5A 1.2m dia Manhole	43	v. meter	\$2,250	\$97,000	\$29,000	\$15,000	\$141,000
Outfall Structure	1	each	\$100,000	\$100,000	\$30,000	\$15,000	\$145,000
Grand - Total:				\$2,647,000	\$794,000	\$398,000	\$3,849,000

Table 8.11 – Future System Option – Sewer from South of Memorial Drive SE – South Plant Option

High Level (Conceptual) Cost Estimate For Outfall Pipe From Future Wastewater Treatment plant							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
600mm Sanitary Trunk (Discharge of 400L/s)	860	meters	\$650	\$559,000	\$168,000	\$84,000	\$811,000
600mm Trunk – Trenchless (Down Escarpment)	830	meters	\$2,250	\$1,868,000	\$560,000	\$280,000	\$2,708,000
Type 5A 1.2m dia Manhole	24	v. meter	\$2,250	\$54,000	\$16,000	\$8,000	\$78,000
Outfall Structure	1	each	\$100,000	\$100,000	\$30,000	\$15,000	\$145,000
Grand - Total:				\$2,581,000	\$774,000	\$387,000	\$3,742,000

Table 8.12 – Future System Option – Sewer from 9 Ave / Redcliff Way SE to SW Plant

High Level (Conceptual) Cost Estimate For Outfall Pipe From Future Wastewater Treatment plant							
Item	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
600 Sanitary Trunk (Discharge of 400L/s)	1,400	meters	\$650	\$910,000	\$273,000	\$137,000	\$1,320,000
Golf Course Rehabilitation	600	meters	\$500	\$300,000	\$90,000	\$45,000	\$435,000
600mm Trunk – Trenchless (Down Escarpment)	500	meters	\$2,250	\$1,125,000	\$338,000	\$169,000	\$1,632,000
Type 5A 1.2m dia Manhole	40	v. meter	\$2,250	\$90,000	\$27,000	\$14,000	\$131,000
Outfall Sewer and Structure	1	each	\$150,000	\$150,000	\$45,000	\$23,000	\$218,000
Grand - Total:				\$2,575,000	\$773,000	\$388,000	\$3,736,000

Table 8.13 – Future System Option Assessment

Future Scenarios – Costing and Commentary – 2,500 Scenario								
Scenario	1A (MH-TWIN)	1B (MH-L)	1C (MH-SS)	2A (NP-L)	2B (NP – MBR)	3A (SE-MBR)	3B (S-MBR)	3C (SW-MBR)
Conveyance Upgrades	Scenario 1	Scenario 1	Scenario 1	Scenario 2	Scenario 2	Scenario 1	Scenario 1	Scenario 1
Conveyance Upgrade Cost	\$13,990,000	\$13,990,000	\$13,990,000	\$14,930,000	\$14,930,000	\$13,990,000	\$13,990,000	\$13,990,000
Flow Management to Medicine Hat	Twinning	Surge Lagoon	Sub-Surface Storage	Surge Lagoon	Surge Lagoon	N/A	N/A	N/A
Flow Management Cost	\$3,504,000	\$2,000,000	\$30,000,000	\$1,000,000	\$1,000,000	N/A	N/A	N/A
Treatment Requirement	N/A	N/A	N/A	Lagoon	MBR Plant	MBR Plant	MBR Plant	MBR Plant
Treatment Cost	N/A	N/A	N/A	\$8,650,000 to \$12,960,000	\$5,391,000 to \$7,641,000	\$5,391,000 to \$7,641,000	\$5,391,000 to \$7,641,000	\$5,391,000 to \$7,641,000
Outfall Sewers	N/A	N/A	N/A	Yes	Yes	Yes	Yes	Yes
Outfall Sewer Cost	N/A	N/A	N/A	\$4,885,000	\$4,375,000	\$3,849,000	\$3,742,000	\$3,736,000
Possible Savings	N/A	N/A	N/A	N/A	N/A	N/A	South Trunk Upgrade Eliminated	South Trunk Upgrade Eliminated
Savings Value	N/A	N/A	N/A	N/A	N/A	N/A	(\$1,600,000)	(\$1,600,000)
Other Possible Costs	Medicine Hat Upgrading	Eastside ASP Lands	N/A	Eastside ASP Lands	Eastside ASP Lands	Eastside ASP Lands	N/A	N/A
Value of Other Costs	up to \$10,000,000	\$2,500,000+	N/A	\$2,500,000+	\$2,500,000+	Cost in Plant Above	N/A	N/A
Total Cost	\$17,494,000 to \$27,494,000 or more	\$18,490,000+	\$43,990,000	\$31,965,000 to \$36,275,000+	\$28,196,000 to \$30,446,000	\$23,230,000 to \$25,480,000+	\$21,523,000 to \$23,773,000	\$21,517,000 to \$23,767,000
Feasibility	Feasible	Feasible if Eastside ASP Sterilization Palatable	Non-Feasible – Excessive Cost	Non-Feasible – Excessive Cost	Non-Feasible – Excessive Cost and Eastside ASP Sterilized	Feasible if Eastside ASP Sterilization Palatable	Feasible	Feasible

Table 8.14 – Feasible Future System Option Analysis

Future Scenarios – Driving and Restraining Forces for Feasible Scenarios					
Scenario	1A (MH-TWIN)	1B (MH-L)	3A (SE-MBR)	3B (S-MBR)	3C (SW-MBR)
Driving Forces	<ul style="list-style-type: none"><li>Easily Workable (Current Configuration)</li><li>No new treatment facility required</li><li>Lowest defined capital cost option</li></ul>	<ul style="list-style-type: none"><li>Simple Variant on Current Configuration</li><li>Lowest defined capital cost option</li></ul>	<ul style="list-style-type: none"><li>Standalone plant makes town self-sufficient</li><li>Avoids high unknown costs in City</li><li>Best practicable treatment technology</li><li>Location of plant could allow west parts of City to utilize</li></ul>	<ul style="list-style-type: none"><li>Standalone plant makes town self-sufficient</li><li>Avoids high unknown costs in City</li><li>Best practicable treatment technology</li><li>Location of plant could allow west parts of City to utilize</li><li>Eliminates some south trunk upgrades</li></ul>	<ul style="list-style-type: none"><li>Standalone plant makes town self-sufficient</li><li>Avoids high unknown costs in City</li><li>Best practicable treatment technology</li><li>Location impacts least developable lands</li><li>Eliminates some south trunk upgrades</li><li>Opens up river terrace lands to development without a lift station</li><li>Best new outfall scenario based on terrain adjacent to river.</li></ul>
Restraining Forces	<ul style="list-style-type: none"><li>Unknown costs in Medicine Hat (could exceed \$10,000,000) – could be highest cost option of feasible scenarios</li></ul>	<ul style="list-style-type: none"><li>Lagoon sterilizes Eastside ASP Lands</li><li>Lowest defined cost at present</li><li>Surge lagoons are messy to maintain</li></ul>	<ul style="list-style-type: none"><li>Outfall upstream of Medicine Hat could be a challenge</li><li>Operating/maintenance costs</li><li>Eastside ASP lands sterilized</li><li>Outfall down escarpment could be a challenge</li></ul>	<ul style="list-style-type: none"><li>Outfall upstream of Medicine Hat could be a challenge</li><li>Eastside ASP lands sterilized</li><li>Very tight envelope to maintain setbacks to City and existing development</li><li>Site at edge of coulee could be unstable</li><li>Outfall down escarpment could be a challenge – it may not be possible for an outfall structure here due to rough terrain</li></ul>	<ul style="list-style-type: none"><li>Outfall upstream of Medicine Hat could be a challenge</li><li>Operating/maintenance costs</li><li>Sewer down escarpment could be a challenge</li></ul>
Commentary	<ul style="list-style-type: none"><li>Worth pursuing more information on costs from the City. Could become best option if costs are palatable, could drop well down the list with high costs.</li></ul>	<ul style="list-style-type: none"><li>Town needs to make a decision if Eastside ASP lands can be sterilized or not.</li></ul>	<ul style="list-style-type: none"><li>There are less expensive MBR scenarios.</li></ul>	<ul style="list-style-type: none"><li>Possible additional savings as some sterilized land is undevelopable escarpment</li></ul>	<ul style="list-style-type: none"><li>Possible additional savings as some sterilized land is undevelopable escarpment</li></ul>
Recommendations	Continue Discussions with City	Determine if Eastside ASP sterilization is workable or not. If palatable, discuss if a surge lagoon is a desired option for the Town.	Drop option	Determine if Eastside ASP sterilization is workable or not. If palatable, consider feasibility assessment for plant as well as outfall down escarpment.	Consider Option. Suggest feasibility assessment for plant as well as for sewer down escarpment.